The Psychology of Special Disability in Spelling

By

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TEACHERS COLLEGE, COLUMBIA UNIVERSITY
CONTRIBUTIONS TO EDUCATION, No. 88

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PREFACE

The experiment here described was carried on during the academic year 1916–1917 at Teachers College, Columbia University. We wished (1) to observe, over a considerable period of time, the learning of pupils with special pedagogical defects, i.e., those pupils who are of normal general capacity, but who are incompetent in one particular school subject; (2) to apply psychological tests to such pupils, with a view to a diagnosis of their disabilities; and (3) to discover and devise, if might be, remedies for such defects. Incidentally we wished also to study the psychological processes involved in mastering the two school subjects, arithmetic and spelling.

Two experiments were therefore undertaken, one with pupils who showed special disability in arithmetic, and another with pupils who showed special disability in spelling. The present report has to do with the group whose defect was in spelling.

The work was so organized that Miss Winford became responsible for the actual teaching of the Experimental Class in spelling. Dr. Hollingworth was responsible for the psychological analyses, and for the planning of specific experiments, and is responsible for the conclusions set forth in this report. Miss Maud Keator, assistant in charge of Experimental Classes in Teachers College, taught the 'Arithmetic Group', which served as a control for the experimental teaching of spelling. Professor E. L. Thorndike originally conceived the plan of studying special defects thus, in experimental classes, and he and Professor F. G. Bonser gave much time and thought to guidance of the work.

Special thanks are due to Mr. Solomon Lowenstein, superintendent of The Hebrew Orphan Asylum of New York City, and to Mr. L. J. Simmonds, assistant superintendent of The Hebrew Orphan Asylum, for their intelligent and sympathetic coöperation. They allowed us freely to select from the children under their care, in Public School No. 192, those who needed special attention such as we wished to give, and they looked after the punctuality and regularity of attendance of the pupils throughout the school year.

The experiment obviously could not have succeeded without this coöperation. Thanks are due, also, to the children themselves, for their readiness to undertake the work, and for their faithfulness to the experiment throughout.

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CHAPTER I

THE PREVIOUS LITERATURE OF SPECIAL DEFECT IN SPELLING

The literature which discusses spelling as a school subject is now fairly extensive. There has been much critical comment on methods of teaching, and on materials taught. We have at hand a considerable number of statistical investigations, bearing on the relation of spelling efficiency to age, grade, and sex; upon the frequency of occurrence of various words; and upon the relative difficulty of various words. Recently Buckingham,[1] Ayres,[2] Starch,[3] and others have devised methods of measuring spelling ability quantitatively, and have given us their spelling scales.

In the present study our interest is only remotely and indirectly related to these aspects of spelling. We set ourselves the task of investigating *the psychology of the processes which are involved in producing that result which we call correctly spelled words;* and our special problem was to discover by means of such investigation, if might be, *what constitutes special defect in spelling ability*, in the case of those children who are 'poor spellers' or 'cannot learn to spell'

The literature touching upon this special problem is very limited. Bronner,[4] in her recent volume on "The Psychology of Special Abilities and Disabilities," writes as follows: "The problems of spelling will be only briefly discussed, for it is quite generally recognized that individuals differ widely in their ability to master this subject. All writers on the question have agreed that many persons well educated are unable to spell correctly. The studies of Rice lead to the conclusion that the amount of time devoted to the teaching of spelling and the methods used have little correlation with the

[1] Buckingham, B. R., Spelling Ability, Its Measurement and Distribution. Teachers College Contributions, No. 59, 1913.

[2] Ayres, L. P., A Measuring Scale for Ability in Spelling, Russell Sage Foundation, 1915.

[3] Starch, D., The Measurement of Efficiency in Spelling, *Journal of Educational Psychology*, 6:127–186. 1915.

[4] Bronner, A., The Psychology of Special Abilities and Disabilities, Little, Brown and Co., Boston, 1917.

results achieved. He found that in various school systems the periods given for teaching spelling vary greatly, but that the results bear no relationship to this factor of time and drill. Methods of teaching used in this field are as yet little determined by any psychological laws. Lay and Abbott and Kuhlmann have studied experimentally the psychological elements involved in spelling, in an effort to find the success that follows auditory presentation of words as compared with visual, and to discover the differences when these processes are accompanied by soft and loud speaking and other motor reactions, such as the movement of the hand in writing. Upon the whole, all studies emphasize the fact that discrimination of sound and association of visual form with the sound of the word are main elements in spelling.

"In our own work we have never concerned ourselves much with any defect for spelling as such, that is, where no other difficulties in learning were found. This attitude has been adopted because of the fact before stated, namely, that many intelligent and well-educated people remain all their lives poor spellers. However, we have noted that poor spelling is often correlated with poor reading ability and at times with other disabilities in language."

In 1892 Wyckoff[5] published an account of tests made on poor spellers. She says, "If a child cannot learn to spell, it is well to locate the difficulty before trying to deal with the case. Knowledge of spelling begins with perception through eye or ear, and ends with the establishment of a train of memories. Somewhere along this line we may find a defective provision."

According to Wyckoff, we have "First, the sensation; second, the direction of attention; third, the retentiveness; fourth, the mental image; fifth, the automatic circuit." Two series of tests were given by this writer, "one for eye and one for ear impressions." As results of these tests Wyckoff concluded:

1. Many constitutional bad spellers have defective sight; some, defective hearing.

2. The same causes that have operated to impair the sight or the hearing, have frequently impaired the retentive power.

3. Constitutional bad spelling may in part be the result of a strong natural bent toward selective attention.

[5] Wyckoff, A. E., Constitutional Bad Spellers, *Pedagogical Seminary*, vol. ii, pp. 448–450, December, 1892.

4. In such cases, where the syllable method of teaching might be especially ineffective, the mechanical memory would be helped by assisting the attention in its selection. For example, above the word *separate* might be written, as an invitation to the eye, the syllable p-a-r.

5. Apperceptive methods should be employed from the outset in the teaching of spelling.

6. It might be well to devise some exercises for perfecting the automatic circuit. Possibly practice in writing with hand concealed, might be of service, use being made of selections that had been memorized.

Carman[6] entertained a theory that "poor spelling is due to poor observation; that is, observation of the words themselves." In order to test this theory, Carman studied eight poor spellers and eight good spellers, adults, all of whom had completed a high school course and spent, on the average, two years more in study. The procedure was to give tests of observation, comprising misspelled words, and material related to misspellings in various degrees—cancellation tests, visual memory for letters, visual memory for forms. The poor spellers were poorer, on the average, in all tests of observation than were the good spellers, but the difference decreased markedly as the data observed became more and more unlike words.

From this result Carman concludes that "Ability to spell well probably implies not a general habit or power of observation, but a special ability to notice small differences in *words*." She recommends the methods of teaching spelling set forth by Thorndike,[7] "in that they teach children to spell by teaching them *to observe the forms of words*."

Brown[8] expresses similar views: "Accuracy or inaccuracy in one's habits of spelling may seem to be quite accidental, or to depend upon the amount of education one has had, and whether he is or is not a close observer, a ready reader or a frequent writer; or the ability to spell may seem to be an inherited trait, as if it came, for instance, from one's maternal grandmother, with the curve of her cheek bone or the color of her hair. But constant practice will soon show that whatever one's habit has been, correct spelling may

[6] Carman, E. K., The Cause of Chronic Bad Spelling, *Journal of Pedagogy*, vol. xiii, pp. 86–87, 1900–1901.

[7] Thorndike, E. L., Mental Training in the Primary School, *School Journal*, December 23, 1899.

[8] Brown, F. W., Learning to Spell, *Education*, vol. xxxiv, p. 582 f., 1913–1914.

be acquired by fixing the attention firmly upon the right form, and holding it there for a sufficient length of time to make the record indelible. How long a time 'a sufficient length' is will, of course, vary according to the receptivity of the student's mind, and the strength of the impression."

At the University of Missouri a plan for improving the spelling of high school pupils was instituted in the high school connected with the School of Education. This work has been reported by Charters,[9] who says, "As is well known, poor spelling in the high school arises from two causes, negligence, on the one hand, and on the other, deep-seated inability to spell, even when care is taken. The number who cannot spell when they try is relatively small."

The general plan of procedure at the University of Missouri was as follows. Any student who in his written work in the courses spelled with reasonable accuracy was not required to attend; but any student who made an average of more than one mistake per page in any papers handed in in any course was obliged to attend the class till he had improved beyond this performance. About ten incorrigibles remained till the end of the first year, out of twenty-five who reported at the start.

In this special class were taught (1) rules for memorizing, such as spelling aloud, spelling to oneself, writing out the words, paying attention, etc.; (2) rules of frequent application, such as doubling the final consonant, dropping final 'e', with exceptions; (3) methods for detecting and correcting errors. All students were required to own a dictionary, and stress was laid upon the fact that in case of the least doubt concerning the spelling of a word, they should investigate it. The students attended for two hours a week the first year and for one hour a week the second year. Those who conducted the work state that "The plan does not insure perfect spelling on the part of all, but it cures the negligent, and helps the incorrigibly poor spellers in some degree."

Cornman[10] has made an analysis of spelling errors from the material collected by him in connection with his study of spelling in the elementary schools. He classifies errors, according to their

[9] Charters, W. W., A Spelling 'Hospital' in the High School, *School Review*, vol. xviii, p. 192.

[10] Cornman, O. P., Spelling in the Elementary School, Ginn & Co., 1902.

origin, as follows: (1) Motorial errors, due to motor incoördination, including additions, omissions, changes, confusion of *m* and *n*, transposition of letters, doubling of wrong letters, attraction; (2) sensory errors, due to sensorial incoördination, including those due to phonetic association, such combinations as *ie* and *ei*, and double letters; (3) errors due to a combination of motorial and sensorial incoördination. Cornman, however, makes no contribution to the psychology of especially poor spellers. His study is of children in general.

Gregory [11] has also made a study of errors. He caused dictation containing selected words to be given to the sixth, seventh, and eighth grades. From his inspection and tabulation of the errors which occurred, Gregory concludes that *the sound of the word* is the chief element in the spelling of children, and suggests that there should be a large amount of oral work, since the greatest percentage of error seems to be due to faulty auditory perception.

Smedley [12] tells us that good spelling is by no means perfectly correlated with excellence of memory, or of sight and hearing. Some children with poor memory, or with sensory defects, rank high in spelling. Thus Smedley concludes that there must be a rational factor in spelling, and that study based on *meaning, derivation* and *rules* is to be recommended.

Kline [13] reports that the learning process in spelling is related to imagery type; also, that of the sensory and motor processes involved in spelling, the former are the source of a greater number of errors than are the latter.

The studies of Rice, Wallin, Suzzalo, Pearson, Starch, Jones, Winch, and Ayres do not bear directly upon our special problem, these investigators being interested in spelling as a school subject, with special reference to methods of teaching, quantitative measurement of the product of instruction, materials taught, and statistics of age, sex, and grade in relation to spelling efficiency.

From this brief summary of fragmentary literature it is evident that special disability in spelling has been recognized by various

[11] Gregory, B. C., The Rationale of Spelling, *Elementary School Teacher*, vol. viii, pp. 40–55.

[12] Smedley, F. W., Child Study Report, *Report of the Commission of Education*, vol. i, pp. 1137–1138.

[13] Kline, L. W., A Study in the Psychology of Spelling, *Journal of Educational Psychology*, 3:381f., 1912.

educators, and that a tentative beginning of the study of the psychological factors involved in spelling has been made. No one has, however, made any extensive study either of special disability, or of the psychology of spelling. A variety of opinion has been expressed, but actual detailed study of cases is lacking.

Common observation itself, indeed, leads us to believe that there are 'poor spellers' who are of normal or superior general ability. Our laboratory was recently visited by a young woman, who was unable to pass college entrance examinations (which are, of course, written), because her communications were so badly spelled. A graduate of a state university, who had been notorious throughout college for her bad spelling, greeted a class-mate with the information that she had at last hit upon a plan to save herself from the mortifications incident to her disability. She said she had a list of the hundred words which caused her the most trouble, and kept them in her pocket. Thereupon she triumphantly produced her written list, and there were twelve misspelled words on it! Such anecdotes might be multiplied. If the disability is present in extreme degree it certainly constitutes a handicap in professional pursuits, since bad spelling is universally regarded as a symptom of illiteracy.

The literature which bears upon interference with the processes of language, in cases of cerebral lesion, and functional nervous disorder, is noted in Chapter VIII, in connection with the theory of special linguistic defect. In Chapter VIII will also be found a discussion of the cases of so-called 'congenital word-blindness', 'congenital aphasia', 'congenital agraphia', and 'congenital alexia', which have been reported by various authors.

NOTE. A very good review of pedagogical studies in the teaching of spelling appeared in *Education*, vol. xxxiv, No. 1, 1913. The author of the review is Mary A. Gruppe.

CHAPTER II

GENERAL DESCRIPTION OF THE EXPERIMENT: AIM, SCOPE, AND METHOD

In order to study intensively the nature and treatment of special defect in spelling, it was decided to conduct in Teachers College a class for school children who showed this disability. The co-operation of the authorities in charge of the children in Public School 192, which is near Teachers College, was solicited, and permission was obtained to select from the enrolment of the fifth grades in this school those pupils who were most in need of the special instruction and help, which it was intended to give.

The question then arose as to how these children should be selected. We wished to avoid all children of low general intelligence, whose disability would be general and not special. To find out whether there were in this school children of good general ability, deficient in spelling only, and to select them, presented a problem by no means entirely simple.

Unfortunately, the monthly reports of the fifth grade children for the year preceding were not available. We submitted the following request to all teachers of fifth-grade rooms in Public School 192: "Please make a list of any pupils in your grade, whose work is satisfactory in the majority of school subjects, but who are deficient in spelling." At the time this request was made the teachers had had the pupils under supervision for five weeks. Replies were received from all five teachers of fifth grade. A total of twenty-five pupils was reported by these teachers as fulfilling the conditions laid down in the request. (The total attendance in the fifth grades of this school was approximately one hundred and fifty pupils.) A variety of misunderstandings on the part of the teachers was revealed. The two commonest errors consisted in a tendency to report pupils who were deficient in school work in general, and the tendency to report pupils who were very much over age for their grade, and whose school work in general was therefore very inferior, though perhaps average for the grade in which they were

placed. This latter error is, of course, merely one more illustration of the tendency of teachers to ignore differences in actual age, when asked to report on the relative ability of their pupils.

We went over these lists and eliminated all children who were mentioned as deficient in more than one school subject besides spelling. We then ascertained the actual age of each of the remaining pupils, and discarded all who were more than two years over age for the fifth grade, according to the age-grade norms of New York City. This left us eighteen pupils who were within two years of the age-grade norm, and were said by their teachers to be deficient in not more than two school subjects, one of which was spelling (the choice being limited, in the majority of cases, to pupils who were said to be deficient in spelling alone).

We then visited the school, and gave spelling, arithmetic, and reading tests to all children of the fifth grades. For this testing we used the Ayres Measuring Scale for Spelling Ability, the Woody Arithmetic Tests, and Thorndike's Reading Scale A. We finally selected fifteen children, within two years of the age-grade norm, declared by their teachers to be deficient in not more than two school subjects (one of which was spelling), who made the lowest scores on the Ayres Spelling Scale. We believe now that very valuable additional data in taking such a census would be found in the *judgments of each other* elicited from the children themselves.[1] Data obtained by the present writer, but not yet published, comprising the judgments of six-year-olds in regard to the intelligence of class-mates, show that such combined judgments select as most able the same children who are selected by intelligence tests. The considerations involved in this matter of taking a census of special defect will be of interest to all school administrators who desire to select children from the grades for special attention.

The selection was completed on October 26, and the Experimental Class opened at Teachers College on October 30, with the fifteen selected children in attendance. Both boys and girls were included. The class hour was from 3:15 to 4:15 p. m. daily. The experiment extended over twenty weeks, divided into two periods of ten weeks each—ten weeks from each semester of the academic year. At the

[1] This suggestion was made by Miss Keator, who during the course of the experiment asked her pupils to arrange each other in an order of merit for ability in arithmetic, and obtained a very illuminating result.

end of the first experimental period, a few of the children originally selected were withdrawn for various reasons unconnected with the class, and a few were dropped from the roll as having attained a proficiency in spelling which rendered them useless for the purposes of the experiment.[2] The places thus made vacant were filled by the judgment of teachers who by the second semester had had opportunity to become thoroughly familiar with the abilities of each pupil, as shown in classroom work. The poor spellers who attended the class the first semester are called in this report the First Semester Group; those who were included during the second semester are called the Second Semester Group.[3] The children in the Arithmetic Class were used as controls in measuring improvement under instruction, etc.

The general procedure was:

1. To teach spelling by a great variety of devices intended to make the subject interesting. The children made a dictionary of words they were sure they could spell, and received a reward when every child had at least five hundred words in his dictionary; they played store, cutting out pictures of various articles from department store catalogues, and spelling the name of each article in large letters; they played competitive games, involving words of various categories; each child kept a diary of whatever had interested him during the day, taking pains to spell all the words correctly, etc.

2. To become personally well acquainted with each child, and to note physical and temperamental difficulties which might conceivably contribute to failure in spelling.

3. To measure quantitatively the improvement of the group, and of individuals, under special instruction.

4. To carry out group experiments in the psychology of spelling, with special reference to the factors involved in failure.

5. To study each child by means of psychological tests, with special reference to diagnosis of his deficiencies.

6. To look for means of removing the causes of failure.

The variability in chronological (actual) age, in mental ability, and in spelling ability, as ascertained during the course of the investigation, may be seen by reference to tables in Chapter III.

[2] Such a child was S. S., who appears in the Control Group for the second semester. She was unwilling to leave the class, and as a compromise was transferred to the Arithmetic Group. Although not deficient in that subject, she was less proficient in it than she had become in spelling, as a result of the special instruction.

[3] The Second Semester Group were in the sixth grade and in Grade 5B, since promotion of children from 5A to 5B, and from 5B to 6A occurred in February.

CHAPTER III

RELATION BETWEEN SPELLING ABILITY AND GENERAL INTELLIGENCE

In order to ascertain whether and to what extent ability to spell could be shown to be a function of General Intelligence in our pupils, correlations were made (1) between Spelling Ability and Mental Age, and (2) between Spelling Ability and Intelligence Quotient. In the first instance we seek to know whether ability to spell correctly is closely related to *mental level.* Shall we expect that an individual who has reached a relatively high mental level will be able to spell better than his fellows of the same school grade, but of lower mental level? When we have ascertained the mental age of each of our children, what prediction with regard to spelling in the case of each can we make on that basis? In the second instance, we seek to know what, if any, relation exists between the *mental quality* of an individual and his ability to spell. Obviously, this question is not identical with the first; for of two individuals of the same mental age, one may be a young child of superior quality, and the other an older child of inferior quality. It might well be that no correlation would be found to exist between mental age and spelling ability, and yet intelligence quotient and spelling ability might be positively correlated. Ability to spell might depend more on *mental quality* than on *mental level,* or vice versa.

As has been stated, the children were divided into two groups, to be designated as First Semester Group and Second Semester Group. Many of the same individuals are included in both groups, as will be seen by reference to the tables. The control group used in the second semester is here called the Control Group, and where these children are combined with the Second Semester Group in obtaining correlations the combination is designated as Mixed Group.

Mental Age and Intelligence Quotient were ascertained according to the Stanford Revision of The Binet-Simon Scale.[1] Together

[1] Terman, L. M., The Measurement of Intelligence, Houghton, Mifflin Co., New York, 1916.

they constitute the measure of General Intelligence. Spelling ability is here defined as the percentage of correctness attained by a given child in spelling certain lists of words from the Ayres Measuring Scale for Ability in Spelling.[2] More specifically, in the case of the First Semester Group ability to spell was measured by combining into an average two trials each of lists P and O. Each list was given twice—once at the beginning of the first semester's experiment, and again at the close of the first semester. The average of these four trials constitutes the measure of Spelling Ability for each child. In the case of the Second Semester Group a similar measure was taken, using in this instance lists Q and R instead of P and O. Thus each child is measured on the Spelling Scale before special instruction and after special instruction, and the combined result determines his rank among his fellows in ability to spell. In all cases the test words were written by the children in columns.

Table I gives the Mental Age, Actual Age, Intelligence Quotient (I. Q.), and Spelling Ability of each child in the First Semester Group, the group standing in the order of their Mental Age. Tables II, III and IV give the same facts for the Second Semester Group, the Control Group, and the Mixed Group, respectively.

TABLE I

Showing Mental Age, Actual Age, Intelligence Quotient, and Spelling Ability of First Semester Group

Name	*Mental Age*		*Actual Age*		*Intelligence Quotient Per Cent.*	*Spelling Ability Per Cent.*
	Years	*Months*	*Years*	*Months*		
J. P.	12	5	10	8	117	93.9
H. A.	12	2	12	2	100	83.5
M. G.	11	6	11	4	101	38.2
B. M.	11	3	11	9	96	84.7
S. S.	11	3	10	1	112	88.0
L. K.	10	10	12	5	85	77.1
S. Sh.	10	10	11	3	96	79.8
S. Sc.	10	9	11	6	94	89.3
E. G.	10	4	11	10	87	83.9
P. J.	10	4	11	5	91	35.7
H. L.	10	1	12	6	81	64.9
M. Gl.	9	10	10	4	95	83.2
R. H.	9	8	12	5	78	88.6

[2] Ayres, L. P., A Measuring Scale for Ability in Spelling, Russell Sage Foundation, 1915.

TABLE II

Showing Mental Age, Actual Age, Intelligence Quotient, and Spelling Ability of Second Semester Group

Name	*Mental Age*		*Actual Age*		*Intelligence Quotient Per Cent.*	*Spelling Ability Per Cent.*
	Years	*Months*	*Years*	*Months*		
R. L.	13	7	12	0	113	90.1
J. P.	12	5	10	8	117	95.2
H. A.	12	2	12	2	100	81.7
M. G.	11	6	11	4	101	31.7
L. K.	10	10	12	5	85	80.2
S. Sh.	10	10	11	3	96	77.9
S. Sc.	10	9	11	6	94	81.8
M. S.	10	9	11	9	92	34.1
P. J.	10	4	11	5	91	32.6
H. L.	10	1	12	6	81	58.9
R. H.	9	8	12	5	78	93.1
M. U.	9	8	12	10	73	57.0
B. N.	9	6	9	11	96	92.1
H. R.	8	3	11	6	72	81.8

TABLE III

Showing Mental Age, Actual Age, Intelligence Quotient, and Spelling Ability of Control Group

Name	*Mental Age*		*Actual Age*		*Intelligence Quotient Per Cent.*	*Spelling Ability Per Cent.*
	Years	*Months*	*Years*	*Months*		
I. K.	13	2	12	3	109	97.7
J. F.	11	4	10	3	111	90.7
S. S.	11	3	10	1	112	92.0
S. O.	11	2	11	6	98	62.0
H. H.	10	4	10	6	98	90.1
I. N.	10	4	11	0	94	91.2
D. H.	9	6	12	1	79	30.2
B. D.	9	1	11	3	81	94.2
H. D.	9	0	11	8	77	89.2

TABLE IV

Showing Mental Age, Actual Age, Intelligence Quotient, and Spelling Ability of Mixed Group

Name	*Mental Age*		*Actual Age*		*Intelligence Quotient Per Cent.*	*Spelling Ability Per Cent.*
	Years	*Months*	*Years*	*Months*		
R. L.	13	7	12	0	113	90.1
I. K.	13	2	12	3	109	97.7
J. P	12	5	10	8	117	95.2
H. A.	12	2	12	2	100	81.7
M. G.	11	6	11	4	101	31.7
J. F.	11	4	10	3	111	90.7
S. S.	11	3	10	1	112	92.0
S. O.	11	2	11	6	98	62.0
L. K.	10	10	12	5	85	80.2
S. Sh.	10	10	11	3	96	77.9
S. Sc.	10	9	11	6	94	81.8
M. S.	10	9	11	9	92	34.1
P J.	10	4	11	5	91	32.6
H. H.	10	4	10	6	98	90.1
I. N.	10	4	11	0	94	91.2
H. L.	10	1	12	6	81	58.9
R. H.	9	8	12	5	78	93.1
M. U.	9	8	12	10	73	57.0
D. H.	9	6	12	1	79	30.2
B. N.	9	6	9	11	96	92.1
B. D.	9	1	11	3	81	94.2
H. D.	9	0	11	8	77	89.2
H. R.	8	3	11	6	72	81.8

Correlations were made between Mental Age and Spelling Ability, and between Intelligence Quotient (I. Q.) and Spelling Ability, using the formula $\rho = 1 - \frac{6\xi d^2}{n(n^2-1)}$, and transmuting the values of ρ into values of r by means of the formula $r = 2sin\left(\frac{\pi}{6}\rho\right)$[3]. The results of this procedure are recorded in Table V, the coefficients of correlation which appear in this table being for values of r. In

[3] For discussion of the use of these formulae, see Mental and Social Measurements, by E. L. Thorndike, published by Teachers College, Columbia University, 1916.

order to test the reliability of our measure of Spelling Ability as here defined, the two lists of words averaged in each instance in determining spelling ability were correlated with each other, by means of the same formulae. This was done also for Mental Age, correlating here the first half of each test with the last half. All of these results are presented in Table V.

TABLE V

Showing All Correlations Obtained for All Groups between Measures of General Intelligence and Spelling Ability, Spelling Ability with Itself, and Mental Age with Itself

Groups	*Mental Age With Spelling Ability*	*Intelligence Quotient With Spelling Ability*	*Spelling Ability With Itself*	*Mental Age With Itself*
First Semester Group	+.237	+.313	+.832	+.803
Second Semester Group	+.081	+.169	+.930	+.943
Control Group	+.419	+.470	+.589	+.940
Mixed Group	+.120	+.342	+.870	+.825

The correlations between measures of General Intelligence and measures of Spelling Ability are extremely small in all groups which are composed of children selected for inability to spell. The inference must therefore be that in the case which we here have under consideration inability to spell is not very closely connected with general mental capacity. Some of our cases show this fact in a very striking way. We may note, for example, the girl, M. G., who ranks well toward the top of the group in all measures of general intellectual ability, but who falls consistently to the bottom in spelling ability. On the other hand, we have the boy, R. H., who is one of the three stupidest children included. He stands consistently among the best in ability to spell words.

As to how far this lack of correlation between General Intelligence and Spelling Ability would hold for groups of children selected at random our data do not inform us. It is true that in the case of our Control Group, composed of children *not* selected for special disability in spelling (but for special disability in arithmetic), the

correlation between Spelling Ability and General Intelligence is appreciably higher than in the groups composed of poor spellers, and this evidence, though not sufficiently extensive to be regarded as a basis for generalization, suggests that among children chosen *at random* (and *not* for special disability in spelling) the correlation between General Intelligence and Spelling Ability might be greatly increased. Working with unselected school children, in the public schools of Alameda, California, Houser [4] found a positive correlation between Spelling Ability and teachers' estimates of General Intelligence, the amounts of the Pearson coefficients of correlation being .596 for Grade 5B, and .346 for Grade 6B. For Grades 4B to 8B, inclusive, Houser obtained an average positive correlation of .530.

The data here under consideration serve to show, at all events, that children of the same Mental Age, the same Intelligence Quotient, and the same school training, may and do differ from each other very greatly in ability to spell; that a child of good intellectual quality may fall far below a child of poor intellectual quality in Spelling Ability; and that it is unsafe to make *a priori* inferences about a child's general ability on the basis of his ability to spell, or about his ability to spell on the basis of his general ability.

On the other hand, the correlations of Spelling Ability with itself and of Mental Age with itself are very high for all groups. The relative ability of a child to spell the words given in one list from the Ayres Scale is a very reliable indication of his ability to spell words in other lists. The relative ability of a child to pass tests of Mental Age in one-half of the Stanford Scale affords a very reliable measure of his ability to pass tests in the other half of the scale.[5]

[4] Houser, J. D., The Relation of Spelling Ability to General Intelligence and to Meaning Vocabulary, *Elementary School Journal*, xvi:190–99, 1915.

[5] It should be explained that by "a half" of the Stanford Scale is meant a *cross section*, obtained by cutting the Scale in half *crossways*, from 3 years through Superior Adult.

CHAPTER IV

RECALL AND RECOGNITION

The questions considered in this part of our experimental teaching were these: (1) Can poor spellers *recognize* the correct spelling of a word on which they have had drill, more easily than they can *recall* it? (2) How many and what kinds of errors are made by poor spellers in recalling and recognizing spellings which have been very well learned, i.e., in reviving bonds [1] which are known to have been well established? (3) Are there any marked differences in these respects between the very poor spellers, and the better spellers of the group?

This experiment was performed in two parts, the first of which may be described as follows:

Words most frequently and persistently misspelled by the First Semester Group in their letter-writing, shop-keeping, and other class exercises, were selected and taught carefully, four at a time, according to the method adopted by us for teaching new words: (1) The word was written on the board by the teacher, she pronouncing it distinctly while writing it; (2) the teacher developed the meaning of the word orally, by giving its definition and calling for sentences using it; (3) the teacher divided the word into syllables, called on pupils to spell orally, by syllables; (4) any 'hard part' was called to attention; (5) parts already known were pointed out; (6) the pupils wrote the word on paper, spelling it in a whisper as they did so; (7) the pupils were called upon to spell orally, with closed eyes, and to pronounce.[2]

In this way the following words were taught during the month of December, 1916, each group being constantly reviewed in class, as additional words were taught:

1. sincerely	4. please	7. cashier
2. respectfully	5. catalogue	8. manager
3. kindly	6. customer	9. owner

[1] The word *bonds* is used here, and throughout this discussion, with the connotation given to it in Educational Psychology, vol. ii, by E. L. Thorndike.

[2] This is essentially the method for presenting new words, which was used by H. C. Pearson in his studies in experimental teaching, reported in *Teachers College Record*, vol. xiii, p. 55, 1912.

10. merchant
11. buyer
12. errand-boy
13. dealer
14. storekeeper
15. automobile
16. squirrel
17. cannon
18. sugar
19. ferry-boat
20. mispoint
21. mistook
22. misuse
23. misread
24. gymnasium
25. stadium

On January 3, 1917, after the two weeks of the Christmas holiday, when the children returned to school, these words were dictated and were spelled on paper by the class. The results of this test are recorded in Table VI under *Recall, January 3, 1917*. On January 10, the children were tested for recognition as follows. Each of the words in the list was written correctly very clearly on an oblong slip of paper, together with two misspellings of the same word. For example:

Fig. 1

The words were so arranged that the correct spelling occurred equally often as first, second, or third word on the slip. These twenty-five slips were then numbered and placed in order, from one to twenty-five, in envelopes, which were given out to the class with these instructions:

Do not open these envelopes till I tell you to do so.

After the envelopes had been distributed, the class was instructed as follows:

Inside of these envelopes are some slips of paper, with words on them. Each slip has three words on it. One of the three is spelled correctly, and the other two are spelled incorrectly. The correct words have all been learned in this class. Now, when I say, "Look at slip number 1," you take the little slip with a '1' in the corner, and put a mark *under* the word that is spelled correctly. The word on number 1 is *sincerely*. Put a line under the correct

spelling. Do not make any other mark on the slip. Look at all three words before making any mark. All ready: Look at slip number 1. Now, put number 1 back into the envelope, and take number 2. The word on number 2 is *respectfully.*

The teacher then proceeded with all the words in the same manner. The results are given in Table VI under the heading, *Recognition, January 10, 1917.*

After January 10, this list of words was completely dropped, and no further attention of any kind was paid to it in the class, until April 23. On that date the recall test was repeated without warning, the children writing the words from dictation, just as they had done on January 3. On April 26, the test for recognition was repeated, precisely as done on January 10. The results from this repetition of the experiment after an interval of about three months, are also given in Table VI.

TABLE VI

Showing the Words Misspelled in Recall and Recognition, by Each Member of the Experimental Class, after an Interval of Two Weeks, and after an Interval of Three Months

H. A.

Recall January 3, 1917	*Recognition January 10, 1917*	*Recall April 23, 1917*	*Recognition April 26, 1917*
catalouge	respectfuly	cincerely	storeheeper
costminer	squrrel	coustomer	suger
merchent	astuidum	squarrel	
autmobile		canon	
suger		suger	
fairyboat		gymnasiam	
gymnasuim		astadium	
astuidum			

M. G.

sincerly	respectfuly	sincerly	merchent
respfully	namager	plase	manerger
knidly	merchent	catolog	storkeeper
cataloge	dearler	coustom	dearler
custona	storkeeper	chare	buyar
chasene	camom	merchent	stadumn
manger	misspoint	dealor	misspoint
merchaunt	misstook	strokeeper	gymnazam
erranboy	missuse	autmobile	missread
dearlar	missread	cana	fairy-boat
storkeeper		suger	catalouge
autonmobile		fair-boat	respectfuly
squirl		misspoint	sincerly
canon		misstook	misstook
suger		missuse	missuse
faryboat		missread	
misstook		gennaz	
misspoint		stadona	
missuse			
missread			
genyanation			
stadum			

TABLE VI (*Continued*)

Recall January 3, 1917	*Recognition January 10, 1917*	*Recall April 23, 1917*	*Recognition April 26, 1917*
P. J.			
respec	buyar	cataloge	namager
contons	fairy-boat	conster	dearler
catyear	stadumn	cashere	
manure		mansh	
honure		orown	
machant		errow boy	
dealar		deal	
ofbell		shopekeep	
squarrel		automobil	
cannad		squrrial	
fairy-boat		cammar	
mistoke		suggar	
misyuase		misure	
(omits gymnasium)		(omits gymnasium)	
station		statue	
M. Gl.			
arrand boy	(all correct)	Not present in April	
costomer			
gymna			
L. K.			
respectfuly	respectfuly	costumer	respectfuly
catolague	namager	aron-boy	eran-boy
manerger	errant-boy	store kepper	suger
aron-boy	mispont	squrrel	mispont
automoble	nisuse	missure	nisuse
squrrel	gymnazam		
farry-boat			
gimnasuim			

TABLE VI (*Continued*)

Recall January 3, 1917	*Recognition January 10, 1917*	*Recall April 23, 1917*	*Recognition April 26, 1917*
H. L.			
respectfuly	respectfuly	sincerly	manerger
catalgue	costermer	catalog	fairy-boat
costermer	squrral	maniger	sincerly
manger	camom	errenboy	catalouge
erranboy	fairy-boat	squarl	
dealar	jimaseum	fairyboat	
outomobile		stadiumn	
squrral			
fairyboat			
jimaseum			
Stadumn			
B. M.			
catologue	squrral	Not present in April	
maniger	misstook		
arrendboy	missuse		
misspoint	missread		
misstook			
missuse			
missread			
gymnazam			
J. P.			
bier	misspoint	feery boat	(all correct)
errendboy	missuse		
squriel	missread		
fairyboat			
gymnaisum			
S. Sc.			
catalouge	(all correct)	catato	storeheeper
cutomer		erandbo	
cashir		gymanum	
errendboy		stadian	
statumn		(omits customer, cashier, manager)	

TABLE VI (*Continued*)

Recall January 3, 1917	*Recognition January 10, 1917*	*Recall April 23, 1917*	*Recognition April 26, 1917*
S. Sh.			
sincerly jymnasium feeryboat	autmobile canont gymnazam	respestfully catologue errend boy storekepper squirreul jumnasium	(all correct)
L. S.			
mannager errend boy cannont suger	respectfuly fairy-boat	Not present in April	
S. S.			
costumer casheir maniger airin boy canon	(all correct)	custumer	(all correct)
R. H.			
sincerly byer canon misspoint misstook missuse missread	(all correct)	erand-boy misspoint misstook missuse missread	(all correct)
E. G.			
squrrel mistoak stadumn gymnazium	gymnazam	Not present in April	

TABLE VII

Showing the Numerical Facts with Regard to Recall and Recognition, Derived from Table VI

	Words Missed			
Name	*Recall January 3, 1917*	*Recognition January 10, 1917*	*Recall April 23, 1917*	*Recognition April 26, 1917*
H. A.	8	3	7	2
M. Gl.	3	1		
E. G.	4	1		
M. G.	22	9	18	15
R. H.	7	0	5	0
P. J.	15	3	15	2
L. K.	8	6	5	5
H. L.	11	5	7	4
B. M.	9	4		
J. P.	5	3	1	0
S. Sc.	5	0	7	1
S. Sh.	3	3	6	0
L. S.	4	2		
S. S.	5	0	1	0

Table VII shows the numerical facts in regard to the mistakes made in recall and recognition. The First Semester Group, including fourteen children, made 109 errors in recall, and 40 errors in recognition. The ten children who took all four tests, made 89 errors in recall, and 32 errors in recognition in January. In April these ten children made 72 errors in recall and 29 errors in recognition. The advantage of recognition over recall holds for practically all individuals. Among the ten children who were present to take the tests again in April, there was an appreciable *gain* in ability to *recall* correct spellings, after the lapse of three months, with no intentional practice on the words involved during the intervening time. Ability to *recognize* correct spellings remained the same (a gain of three words for the group being insignificant, and within the bounds of mere chance).

This result was contrary to our expectations, as we had supposed there would be a marked falling off in ability both to recall and to

recognize these words, after a period of three months, with no intervening review or drill. No effort was made to insure that the children would *not* see or use any of the words in the interval between tests, as to insure this would have been impossible. Whether or not a child should see any of the test words in the interim, was left wholly to chance.

TABLE VIII

Showing Correlation (by Relative Position) between Spelling Ability as Measured by Lists P and O in the Ayres Scale, and Spelling Ability as Measured by the Number of Errors Made in Recall and Recognition of Words Specifically Taught

Name	*Recall and Recognition (January)*	*Ayres*	*Name*	*Recall and Recognition (April)*	*Ayres*
M. Gl.	1	8	J. P.	1½	1
S. S.	3	4	S. S.	1½	4
S. Sc.	3	2	R. H.	3	3
E. G.	3	7	S. Sh.	4	6
S. Sh.	5	9	S. Sc.	5	2
R. H.	6	3	H. A.	6	5
J. P.	7	1	L. K.	7	7
H. A.	8	5	H. L.	8	8
B. M.	9	6	P. J.	9	10
L. K.	10	10	M. G.	10	9
H. L.	11	11			
P. J.	12	13			
M. G.	13	12			

Using the formula $\rho = 1 - \frac{6\xi d^2}{n(n^2-1)}$, and transmuting the values of ρ into values of r, as in Chapter III, the correlation between 'recall and recognition for January' and the Ayres Scale is + .609; that between 'recall and recognition for April' and the Ayres Scale is + .874. (The ranking under recall and recognition was obtained by adding the errors made in both processes together, and then ranking the children according to the number of errors made by each, from least to most.) It is interesting to note that the

poorest spellers consistently fall to the bottom. The reduction from perfect correspondence in rank comes among the good and mediocre spellers. When *specific* effort is put forth to learn *particular words*, it is not always the best spellers of these particular words who are also the best spellers of the words on the Ayres Measuring Scale. Some changing about takes place in ranking among these toward the top of the group. But the poorest spellers do not rise by specific effort to a higher place among their competitors. They simply are not able to learn as well as their fellows do, and maintain their inferior rank throughout.

TABLE IX

Showing Correlation (by Relative Position) between Spelling Ability as Measured by Ayres Lists P and O, and Spelling Ability in Recall and Recognition (Separately Considered) of Words Specifically Taught

Name	*Recall January and April*	*Ayres*	*Name*	*Recognition January and April*	*Ayres*
J. P.	1½	1	S. S.	1½	4
S. S.	1½	4	R. H.	1½	3
S. Sh.	3	6	S. Sc.	3	2
R. H.	4½	3	J. P.	4½	1
S. Sc.	4½	2	S. Sh.	4½	6
L. K.	6	7	P. J.	6½	10
H. A.	7	5	H. A.	6½	5
H. L.	8	8	H. L.	8	8
P. J.	9	10	L. K.	9	7
M. G.	10	9	M. G.	10	9

In Table IX the errors made in recall in January and those made in recall in April were added for each child; and the errors made in recognition in January and in April were added for each child. The rankings in recall and in recognition with the ranking on the Ayres Scale were then correlated separately. Using the same formula as used before, we find that the correlation between *Recall* and *Ayres* is + .818; between *Recognition* and *Ayres* the correlation is + .735.

The number of cases is, of course, too small to yield conclusive data so far as the actual size of these coefficients is concerned. What especially interests us is the behavior of the very poorest spellers in these various processes. The poorest spellers in every test up to this point have been P. J. and M. G. In *recognition* of words taught, P. J. skips surprisingly up to equal children who have stood consistently above her in all other tests of spelling. We have evidence here that all the bonds involved in the spelling process (see p. 79 of this monograph) were not equally weak in the case of P. J. Those bonds which enable the individual to call the symbols up in the proper sequence when the word is uttered, were especially feeble in this child. She knew the meaning of the words, could articulate them, could recognize the correct spellings when presented among incorrect spellings, could copy the words, and could write them. But she could not call the letters up in the proper sequence. M. G., on the other hand, is the poorest of the group in recognition as well as in recall.

In the second part of the experiment in recall and recognition, the children of the First Semester Group, who returned as part of the Second Semester Group, are presented as subjects. There were nine of these children. In this part of the experiment we adopted a definition of learning, we used words of known difficulty, and we gave ten trials each for recall and for recognition. It would have been desirable to have carried out the experiment with children who were all equally unfamiliar with the words on the list to be taught, but it was impossible to satisfy this condition in our work.

One of Buckingham's[2] lists of words of known difficulty was used. Many of these words had already been learned or partially learned by our children before the experiment began. We called a word *learned* by a child, when that child was at least able *to spell it on five successive days without error.*

Every child *learned* every word in this list, except M. G., who was never able to spell her words on five successive days without error. This child was very anxious to succeed, but was unable to do so.

Buckingham reports his lists of words as follows: "The following lists are offered as lists of equal difficulty. The sum of the P E. values in each is 976 or 977. In using them the words may be

[2] Buckingham, B. R., *op. cit.*, p. 53.

weighted as indicated, or may with no great loss in precision be each given a credit of one."

1. Tuesday	16	11. raise	17	21. nails	14
2. forty	18	12. touch	17	22. butcher	15
3. towel	20	13. tying	19	23. cousin	17
4. against	22	14. minute	20	24. choose	26
5. guess	24	15. saucer	27	25. pigeons	28
6. answer	16	16. freeze	18	26. bought	12
7. instead	18	17. wear	19	27. pretty	13
8. whole	21	18. pear	20	28. stopping	23
9. janitor	21	19. button	21	29. telephone	25
10. carriage	24	20. sword	22	30. saucy	27

When the words had all been learned by all the children (except M. G.) they were laid aside for one week. At the end of that time they were dictated, without previous warning, by the teacher, and the children wrote them on paper. Thereafter the words were given out at intervals of one week for recall, with no reference to them in the meantime, except for the weekly test of recognition, which was carried out as follows:

Each of the words in Buckingham's list was written correctly in black crayon on a long piece of manilla wrapping paper, together with *nine* misspellings of the word, for example:

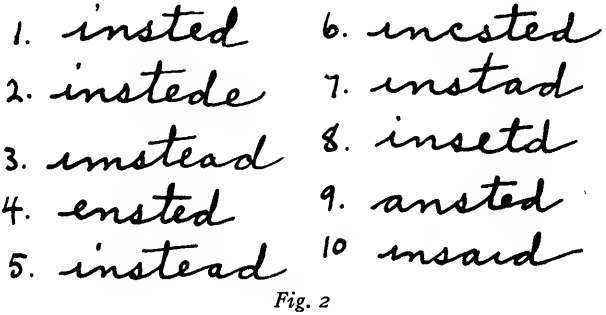

Fig. 2

The correct spelling occurred in random order, so that no advantage to it might accrue from its position in the lists. In the preceding work it was felt that three alternative spellings were not sufficient to eliminate chance as a factor in choosing the correct one. For this reason we provided ten alternatives in the second experiment.

The class was instructed thus:

I am going to show you a list of ten words. They are really just different spellings of the *same* word, but nine of the spellings are wrong, and only one is right. Look carefully, and then write on your paper the *number* opposite the spelling that is *right.*

The lists were then exposed in order, for thirty seconds each, before the class. The children were directed to write the *number* of the correct spelling, instead of the spelling itself, because in copying, some of them might fail to put down the correct letters, even though the correct spelling had been *recognized.* To recognize the correct spelling involves different bonds from those involved in copying it. (See Chapter VIII.) We did not use different orders of the misspellings from trial to trial, but used the same lists for each trial. We now feel that this was a flaw in method, which may have hindered us from obtaining more complete results from the experiment on recognition. The experiment should be repeated, with a different order of misspellings at each trial. Inspection of the records shows, however, that the same errors were not made by the same children at successive trials, which would tend to happen if a given misspelling had come to be associated with a given number in the course of repeated trials. It is also true that the children were never told that the experiment was to be re-tried, so that there was never any incentive for them to look up words, or to try to remember the position of words. So far as they knew, each trial was the last one.

Table X gives the number of errors made by each child at successive trials for recall, and also the total number of errors for the group.

TABLE X

Showing Errors Made, on Successive Trials, in Recall of Buckingham's Words of Known Difficulty

Name	*January 19*	*February 6*	*February 14*	*February 20*	*February 27*	*March 9*	*March 16*	*March 23*	*March 30*	*April 20*	*Total*
R. H.	0	0	0	0	0	0	1	1	0	0	2
J. P.	1	0	0	1	1	0	1	1	1	0	6
P. J.	0	3	2	1	0	0	1	0	0	0	7
S. Sc.	3	1	3	0	2	3	0	1	0	1	14
L. K.	0	3	3	1	1	2	1	5	2	1	19
S. Sh.	1	3	3	3	5	1	1	1	3	2	23
H. L.	0	4	3	6	6	1	1	1	1	1	24
M. G.	0	2	3	3	4	2	1	4	1	4	24
H. A.	2	5	5	1	1	3	2	5	3	2	29
Total	*7*	*21*	*22*	*16*	*20*	*12*	*9*	*19*	*11*	*11*	*148*

TABLE XI

Showing Errors Made, on Successive Trials, in Recognition of Buckingham's Words of Known Difficulty

Name	*February 19*	*March 5*	*March 12*	*March 16*	*March 21*	*March 26*	*April 2*	*April 16*	*April 23*	*April 30*	*Total*
R. H.	0	2	1	1	0	0	1	0	0	0	5
P. J.	0	1	0	1	1	1	0	1	0	0	5
J. P	2	1	0	0	1	1	0	0	1	0	6
L. K.	0	1	2	1	1	0	0	1	1	0	7
H. L.	2	2	1	0	3	0	1	1	1	1	12
S. Sc.	3	1	0	2	0	0	2	4	1	1	14
S. Sh.	0	2	6	1	1	1	2	2	2	0	17
H. A.	0	1	0	3	1	0	1	5	4	3	18
M. G.	3	3	3	1	4	3	2	3	5	5	32
Total	*10*	*14*	*13*	*10*	*12*	*6*	*9*	*17*	*15*	*10*	*116*

The nine children of the First Semester Group, who returned to us the second semester, made 148 errors in recall of the thirty words, in the course of ten successive trials, an error being defined as *a misspelled word*, regardless of the kind or degree of the misspelling. The curve which results from platting the number of errors for the ten successive trials, and which is presented in Fig. 3, shows no consistent trend whatever. It does not ascend, nor, on

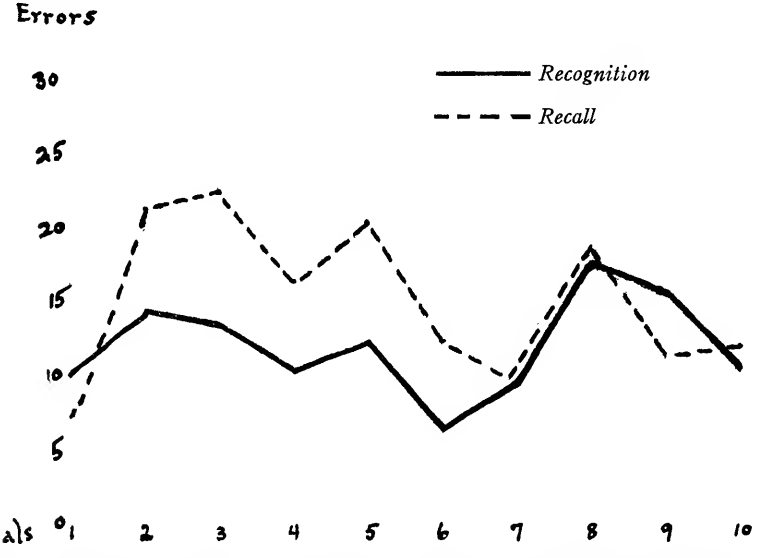

Fig. 3—Showing Errors Made on Successive Trials, in Recall and Recognition of Buckingham's Words of Known Difficulty, the Words Having Been Well Learned

the other hand, does it show a consistent trend in the direction of improvement. The curve simply shows the fluctuations in performance, which are characteristic of all curves of work, and which we call 'chance variations', because we do not know the specific cause of the fluctuations in each case. Inspection of the individual records shows that the variations in performance for the group, as a whole, are due to fairly large 'chance' variations in the scores of individuals; and not to any general tendencies affecting all individuals at the same time. For example, on March 23, the group made twice as many errors as on March 16, but this difference is due entirely to the two individuals, L. K. and M. G. It is true that there are fewer errors on

the first trial than on any succeeding trial, but the seventh trial falls almost to the level of the first trial, and so do the ninth and tenth.

Our conclusion is that of words learned *very thoroughly* (so thoroughly that learning is defined as being able to spell them on five successive days without error), no consistent weakening of the bonds takes place within a period of eleven weeks after the learning. It is evident that we required *over-learning* on the part of our pupils, to such an extent that in the course of eleven weeks we were unable to obtain even the beginning of a true Curve of Forgetting.

For the teaching of spelling, it is important to know just what minimum amount of 'learning' should be required, in order to establish permanent bonds. Since our experiment was closed at the end of ten weeks, we are unable to say whether or not the bonds formed so well that the children could spell each word correctly on five successive days without error were permanent bonds. Perhaps at the end of fifty weeks these bonds would have shown a consistent tendency to weaken. The establishment of this point must rest on a more protracted experiment than ours.

In the ten successive tests of recall a total of 2,700 words was spelled by our nine children (nine children spelled thirty words ten times). Since they made a total of 148 errors, this means that they gave back only 5.4 per cent. of error in the course of the experiment. This record approaches perfection. Yet, since a small percentage of error was made, the question arises as to what caused these mistakes. The curve shows that they were not due to a progressive weakening of the bonds formed. What, then, caused the 148 errors?

Analysis shows that many of them were evidently due to *lapses* (see p. 38). Frequently a child misspelled a word once only, in ten trials. We infer that in such cases the bonds cannot be fairly said to have weakened; but that the child 'lapsed' from what he knew to be correct, through one or another of the psychological processes described on p. 38. This is shown in such examples as the following: R. H. spelled 'against' correctly on the first, second, third, fourth, fifth, and sixth trials; on the seventh trial he spelled it 'a-g-a-n-s-t'; on the eighth, ninth, and tenth trials, he spelled it correctly. P. J. spelled 'choose' correctly on the first trial; on the second trial, she spelled it 'c-h-o-s-e'; on the third, fourth, fifth, sixth, seventh, eighth, ninth, and tenth trials, she spelled it correctly.

TABLE XII

Showing Distribution of Errors in Recall, for Ten Successive Trials

Name	*Word*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
R. H.	against nails				✓			aganst	nailes		
J. P.	pigeons	pegeons			piegons	piegons		piegons	piegons	piegons	
P. J.	choose sword bought butcher raise nails		chose sord rise	. (omits) (omits)	 butch			 nailes			
S. Sc.	telephone saucer minute carriage against guess tying nails	telepone saucy trying	scucy	telphone saucy minuite		telphon carriag	telphone against guest		against		 nail

TABLE XII (*Continued*)

Name	*Word*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
L. K.	saucer		scourse	source	saurcer	source	sourcer	sourcer	sourcer	saurce	
	choose		choos								
	sword		sowrd						sowrd		
	saucy			sucy							
	pretty			preety					preety		
	nails						naile		nailes	nailes	nailes
	whole								whol		
H. L.	saucer		sawer	sawer	sawer		sawer				
	pigeons		pigons	pigons							
	guess		guest								
	saucy		sawy	sway	saway						
	forty				fourty	fourty				fourty	fourty
	instead				insteat	isted					
	stopping				stoping						
	wear					where					
	bought					caught					
	carriage							carrage			
	towel								towl		
	tying				tyeing	tiying					
	choose					shoes					

TABLE XII (*Continued*)

Name	*Word*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
S. Sh.	freeze	feeze									
	wear		ware	ware	ware	ware					ware
	pretty		preety				preety				
	stopping		stoping							stoping	stoping
	pigeons			pigons		(omits)			pigons	pigions	
	Tuesday			Tuesdy							
	pear				pare	pare					
	saucer				sawcer						
	touch					stoush					
	carriage					(omits)		cariage			
	nails									nailes	
M. G.	pigeons										
	stopping		pigions	pigeions	pigeions	pigeon	pigeions	pigeions	pigeions	pigeions	pigeouns
	pretty		stoping								
	cousin			petty							counsin
	instead			counsin							
	sword				instaed						
	wear				soword						
	pear					ware					
	against					pare					
	touch					against	tuch				
	whole								whol		

TABLE XII (*Continued*)

Name	*Word*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
M. G.	minute telephone saucy butcher								minte telphone		saucey buttcher
H. A.	raise cousin tying nails pigeons guess instead pear stopping towel wear janitor telephone	rse cousine	tyeing nailes pigons guss intsead	rais nailes pgons pair stoping	pigones	nailes	nailes touel weare	nailes weare	cousine nailes pegeons weare janitore	raize nailes weare	nailes telephoon

A large number of the 148 errors were of the kind just described, where a child lapsed from the correct spelling but once in the course of ten trials; but there were also instances where a child showed persistently weak bonds, and contributed a given error consistently at nearly every trial. Examples of this are the following: J. P. spelled 'pigeons' as 'p-e-g-e-o-n-s' on the first trial; correctly on the second and third; as 'p-i-g-o-n-s' on the fourth; as 'p-i-e-g-o-n-s' on the fifth; correctly on the sixth; as 'p-i-e-g-o-n-s' on the seventh, eighth, and ninth; correctly on the tenth. The bond involving 'e' was weak, and this one persistent and genuine weakness caused all of the six errors contributed by J. P. H. A. spelled 'nails' correctly on the first trial; as 'n-a-i-l-e-s' on the second and third; correctly on the fourth; as 'n-a-i-l-e-s' on the fifth, sixth, seventh, eighth, ninth, and tenth. The bond between 'l' and 's' was weak, and admitted of the intrusion of an erroneous element. This one persistent weakness contributed eight errors to the 148. Tabulation of errors according to the number of times each was made by a given child yields this result.

Errors made once each by the children making them,	46 — 46
Errors made twice each by the children making them,	13 — 26
Errors made three times each by the children making them,	4 — 12
Errors made four times each by the children making them,	7 — 28
Error made five times by the child making it,	1 — 5
Error made six times by the child making it,	1 — 6
Errors made eight times each by the children making them,	2 — 16
Error made nine times by the child making it,	1 — 9
Total	*148*

The nine children made 116 errors in recognition of the thirty words, in the course of ten successive trials, an error being defined as *indicating the wrong spelling*, regardless of the kind or amount of 'wrongness' involved. The curve which results from platting the number of errors made on successive trials (See Fig. 3) here also shows no consistent trend in any direction. Like the curve for recall, it shows merely the variations in performance, due to 'chance'

We find here, as in the first experiment on recall and recognition, that the children recognized the correct spelling of a word more readily than they could recall it. The questions arise as to whether those words which are most often mistaken in recognition are

also the most difficult to recall; and also as to whether the children who recall words with least facility are at the same time the poorest in recognition. When the thirty words are correlated with respect to relative difficulty in recall and in recognition by the formula $\rho = 1 - \frac{6\xi d^2}{n(n^2-1)}$, (values of ρ being transmuted into values of r), a correlation of +.333 is obtained. This means that a word easily recalled may not be easily recognized; that there is not a close relation between the recallability of individual words and their recognizability. For instance, 'pigeons' is decidedly the most difficult of the thirty words in recall; but its position is only 17.5 among the thirty in the order of difficulty for recognition. It was mis-recalled twenty-nine times, but was mis-recognized only three times. In recognition, 'stopping' was mistaken by the children more often than any other of the thirty words; it was mis-recognized fourteen times, but was mis-recalled only six times.

Do children who recall spellings with the least facility also fail most often to recognize correct spellings? We obtained a correlation of +.93 between ability to recall and ability to recognize spellings. This coefficient of correlation is unreliable for children in general, because of the smallness of our group; but for this particular group we may conclude that those children who make many errors in recall also make many errors in recognition, of words learned, *but* that the errors made in recall are in only a small percentage of cases the same errors as those made in recognition.

As for the two very poor spellers, P. J. and M. G., they show no tendency to differ qualitatively from the rest of the group. They, like the others, make more mistakes in recall than in recognition; they, like the others, most frequently misspell words *learned*, but once each in ten successive trials. But there is a notable difference between these two children in ability to raise their relative position in their group by means of strenuous effort. P J., by extraordinary effort, succeeds in attaining third place in the group in recall, and first place in recognition. She was the last child to 'learn' her words, but once having learned them she retains them for ten successive trials as well as does J. P., who was the first child to 'learn' them. M. G., on the other hand, remains at the bottom of the group, in spite of faithful application to the task in hand (in the hope of attaining a desired reward).

CHAPTER V

DETERMINANTS OF ERROR IN SPELLING

LAPSES

In the course of the daily work with individual pupils, and on inspection of the scores of misspellings preserved as a daily record of achievement in the Experimental Class, we noticed that error is by no means a senseless and uncaused phenomenon, but that, on the contrary, certain factors are constantly or intermittently at work, both to cause error and at the same time to limit its extent. Among the most frequent and most interesting errors were those due to *lapses*. These errors are committed by children who 'know better', who can correct the mistake spontaneously as soon as *attention* is called to it. In popular parlance, these errors are characterized as 'slips of the pen', 'slips of the tongue', etc. Psychologically, we have arrived at the following classification of such misspellings due to lapses:

(*a*) Errors which result from automatically copying the ending of a word that is just *above* the word being spelled e.g., close*t*
clock*t*

(*b*) Errors which result from automatically including a syllable of a word that is to *follow* the word being written, and which is therefore coming 'to mind' as that word is being finished, e.g., 'postard card'. This seems to occur especially when there is marked *similarity* between the two syllables, as in the example given.

(*c*) Errors which result from a tendency to omit, in written spelling, one of two letters which require a similar motor response for their execution, e.g., 'sd' for 'sad', and 'gld' for 'glad'.

(*d*) Errors which result from writing a letter that has common kinaesthetic elements *instead of* the correct letter, e.g., 'dod' for 'dog', and 'forn' for 'form' (In such cases the nervous system seems to satisfy itself with executing a part instead of a whole.)

(*e*) Errors which result from substituting a letter that has common visual elements instead of the required letter, e.g., 'goiny' for 'going', and 'storeheeper' for 'storekeeper'.

(*f*) Errors (very common) which result from substituting a letter that has common phonetic elements for the required letter, e.g., 'celect' for 'select', and 'podchees' for 'potcheese'.

(*g*) Errors which result from transposing two adjacent letters, as is so often done in typewriting, e.g., 'Indain' for 'Indian', and 'mintue' for 'minute'

(*h*) Errors which result from perseveration of an element, especially a dominant element, in a word just used, e.g., 'the theeth' for 'the teeth'

(*i*) Errors which result from a tendency to omit the last letter of the word being written, when the initial letter of the next word has the same or a similar sound, e.g., 'advise to' for 'advised to'.

(*j*) Errors due to doubling the wrong letter in a word which contains a doubled letter, e.g., 'frezze' for 'freeze'.

The origin and classification of linguistic lapses have been investigated and discussed by Meringer and Mayer,[1] by Bawden,[2] and by Wells.[3] For a detailed elaboration of the subject, the reader is referred to the work of these authors, and particularly, to the study of Wells. We cannot add anything of value to their results from the data which we accumulated, except mention of the observation that 'lapsing' constitutes a considerable factor in the work of poor spellers.

Wells says, "There are four normal linguistic processes, two sensory, the visual and the auditory, and two motor, the phonetic and the graphic Each of the above linguistic processes is subject to its own peculiar lapse. A lapse is the involuntary modification of any linguistic sensation or movement to another linguistic sensation or movement. The process itself is always central, no matter what its source of excitation. Lapses are not only involuntary, they are for the most part also unconscious, i.e., there is no awareness of them until their primary memory has been lost. Inattention is the first requisite of the lapse.

It has yet to be demonstrated that, so far as the higher mental processes are concerned, the lapse is anything other than a product of inattention, which permits the disturbing element to enter consciousness, and the law of suggestion, which permits it, when there, to express itself in a corresponding perception or movement."

[1] Meringer und Mayer, Versprechen und Verlesen, Stuttgart, 1895.

[2] Bawden, H. H., A Study of Lapses, *Psychological Review Monthly Supplement*, vol. iii, No. 4, 1900.

[3] Wells, F. L., Linguistic Lapses, *Archives of Psychology*, No. 6, 1906.

The Freudian [4] hypothesis that such phenomena are traceable to the suppression of wishes and of disagreeable complexes was not utilized in any way in our study of error, as the lapses of our pupils seemed explicable by much simpler psychological facts.

IDIOSYNCRASY

Scrutiny of the misspellings of our children reveals another peculiar phenomenon, which is perhaps akin to lapsing, but not identical with it. This is the marked tendency of an occasional child to commit the same characteristic kind of blunder over and over again; that is, the child has an *idiosyncrasy* for certain kinds of errors. Two of our children showed such idiosyncrasies. These children were M. G. and H. A.

In the case of M. G. the idiosyncrasy consisted in introducing certain *intrusive letters* into her spellings; for example, 'c-o-u-n-s-i-n' for 'cousin', and 'w-r-i-n-t-i-n-g' for 'writing' Among students of language this tendency to introduce 'n' in *pronouncing* words, is recognized as common among relatively illiterate persons, and has been referred to as 'the intrusive n' [5] M. G. shows a *penchant* not only for 'the intrusive n', but also for other intrusive letters, as the following examples will indicate:

h-u-s-d-b-a-n-d = husband
d-e-a-r-l-a-r = dealer
m-a-n-e-r-g-e-r = manager
a-u-t-o-n-m-o-b-i-l-e = automobile
v-i-s-i-n-t-i-n-g = visiting
f-a-r-t-h-e-r = father
s-u-r-g-r = sugar

The presence of this idiosyncrasy in the case of M. G. increases the total number of her errors by only a relatively small percentage, as her spelling was so very poor in general, and in so many different ways. Nevertheless, this one *kind* of error occurs more frequently than any other one *kind* in her work, and is sufficiently conspicuous to draw attention to itself.

The idiosyncrasy of H. A. consisted in a *penchant* for adding final 'e' to any and all words, and for ending the plural in 'es' For

[4] Freud, Sigmund, Mistakes in Reading and Writing, *The Psychopathology of Everyday Life.* (Translation by A. A. Brill), Macmillan, New York, 1916, p. 117f.

[5] Pound, Louise, Intrusive Nasals in Present-Day English, ENGLISCHE STUDIEN, 45, 1912.

instance, he wrote 'n-a-i-l-e-s' for 'nails', and 'w-e-a-r-e' for 'wear' This idiosyncrasy in the case of H. A. is responsible for a considerable percentage of the total of his errors. The following examples of his misspellings will serve to illustrate the point.

b-e-g-a-n-e = began
a-l-s-o-e = also
h-o-u-r-e-s = hours
w-h-o-m-e = whom
p-e-r-h-a-p-e-s = perhaps
c-l-e-r-k-e = clerk
f-o-r-e = for
l-o-o-k-e = looked

The number of our pupils was not sufficient to admit of a thorough study of the subject of idiosyncrasy. In a study including several hundred children, enough data might be gathered to constitute a basis for the formulation of some conclusion regarding its psychological origin.

DISTRIBUTION OF ERROR WITH RESPECT TO SYLLABIC SEQUENCE

The questions here were: (1) Of words taught, does error in recall occur most frequently in monosyllables, in dissyllables, or in polysyllables? (2) Does error distribute itself equally among all syllables? Or does its frequency show a relation to the sequence of syllables? Does one part of a word have an advantage over other parts with respect to liability to error?

Fifty words were taught to fourteen pupils (First Semester Group),[6] and later recalled by them (written by them on paper from dictation), making a total of 700 recalls. Of these words, eleven were polysyllables; twenty-seven were dissyllables; and twelve were monosyllables. This gives us

11 polysyllables	spelled by fourteen children—	154
27 dissyllables	spelled by fourteen children—	378
12 monosyllables	spelled by fourteen children—	168
Total 50 words		700 words

[6] One of the fifteen children originally selected had to be dropped in the first week of the experiment, because of his inability to become adjusted to other members of the class.

The errors made in these 700 spellings were distributed thus:

	Initial Syllable	*Intermediate Syllable*	*Ultimate Syllable*	*Total*
Polysyllables	19	52	31	102
Dissyllables	37		60	97
Monosyllables	28			28

Of the 700 initial letters of these words, only fifteen were erroneously recalled.

This result shows us that *in polysyllables* taught, the children gave back 12 per cent. of error in initial syllables; 34 per cent. of error in intermediate syllables; and 20 per cent. of error in ultimate syllables. *In dissyllables*, the children gave back 9.7 per cent. of error in initial syllables, and 16 per cent. of error in ultimate syllables. *In monosyllables* the children gave back a total of only 16.6 per cent. of error. Only 2 per cent. of *initial letters* were erroneously recalled by the children.

It is clear that the first elements in words have a decided advantage over final elements, and that both first and last elements have a distinct advantage over intermediate elements. This is consistent with the experimental results from studies of memory span for digits and nonsense syllables. The initial element in words (the first letter) is almost invariably recalled correctly, even by the poorest of our spellers. The implication for pedagogy here seems to be that stress should be placed on intermediate and final syllables in the teaching of new words, as the initial element tends to take care of itself. This is true of the best of our spellers (J. P., R. L., and S. S.), as well as of the poorest. The facts stated apply to all children in our Experimental Class.

It is of interest to note here how our findings bear upon the results of experimental studies in the psychology of reading. Goldscheider and Müller [7] found that the first letter of a word is almost always one of the 'determining' letters for the proper reading of the word. In their experimental work with mutilated words, they showed that if the first letter is lacking, the recognition is apt to fail, especially if its absence breaks up an initial diphthong. For example, *ewis* did not give *Beweis* as intended, but *edelweis; ia n se* was not read as *Diagnose*, but *D a nose* was so completed.

[7] Goldscheider und Müller, Zur Physiologie und Pathologie des Lesens, *Zeitschrift für Klinische Medizin*, Band 23, s. 131.

Huey [8] made quantitative tests of the comparative importance of first and last halves of words for correct reading, by having readers read passages from which the first half of each word was carefully removed in the one case, and the last half in the other. It was found that more words were made out, in less time, when the first halves were read alone, than when the last halves were read alone. The four readers tested averaged .49 words per second when reading from the first halves, as against .33 words per second when reading from the last halves.

Huey [9] says, "Among the factors which cooperate to produce this result may be mentioned, first, the tendency of English to place the accent upon the first part of the word, the accented part then tending to represent the word; second, the preponderance of the number of suffixes over prefixes, the main root of the word tending to appear in the first part, thus rendering the first part more important. It seems probable also, as a third factor, that the time-order in ordinary inter-association of syllables has much to do with the difference shown. This time-order has almost always been from the first part toward the latter, and, as has been shown by various experiments, associations do not work nearly so well in reversed time-order."

Our tabulations show us, furthermore, that polysyllables suffer far more from error than dissyllables do, and that monosyllables suffer least of all. This result would be expected on the principle that the difficulty of recall increases, all other factors being equal, with the increase in number of prescribed elements. Ayres [10] reports that, "The correlation between the spelling difficulties and the lengths of the words, computed by the Spearman method, gives a coefficient of .882, while the percentage of unlike signed pairs gives a coefficient of .767 and Galton's graphic method one of .78." Ayres further says, "This close relationship between the length of the words and their difficulty is probably to be accounted for in part by the fact that mere length tends to increase spelling difficulty and in addition, the longer the word is, the more opportunities it presents

[8] Huey, E. B., Preliminary Experiments in the Physiology and Psychology of Reading, *American Journal of Psychology*, July, 1898.
Huey, E. B., Psychology and Physiology of Reading, *American Journal of Psychology*, vol. ix, pp. 1–20, and vol. xii.
[9] Huey, E. B., The Psychology and Pedagogy of Reading, Macmillan Co., New York, 1915.
[10] Ayres, L. P., *op. cit.*, pp. 38–39.

for difficult combinations of letters and difficulties arising through inaccurate pronunciation."

The implication for pedagogy is obvious; the amount of time and effort consumed in teaching children to spell words must be increased as the number of elements increases. It will take, in the long run, more effort for the teacher to teach and for the children to learn polysyllables, than to teach and learn monosyllables.

Up to this point we have assumed that the greater difficulty of polysyllables and dissyllables as compared with monosyllables is due simply to the fact that as the number of syllables increases, the number of letters in the word also increases, so that monosyllables are, on the average, *shorter* than dissyllables, and dissyllables are, on the average, *shorter* than polysyllables. But it may be that the very fact that the word is *syllableized* enters as a psychological influence, to increase or to decrease difficulty.

In order to throw light upon this point, we must compare monosyllables, dissyllables and polysyllables of the same number of letters. The comparison between monosyllables and polysyllables in this respect is difficult, for few monosyllables contain more than five letters, and few polysyllables contain less than six letters. Comparison between monosyllables and dissyllables is, however, relatively easy to make. Comparison between monosyllables of five letters and dissyllables of five letters, yields the result that of such words, presented to the class with equal frequency, the former showed 9.8 per cent. of error on recall, and the latter showed 10.7 per cent. of error on recall. The difference here shown is insignificant. It would lead us to the conclusion that we were correct in assuming that the difficulty of words depends, other things being equal, upon the number of *letters* which they contain, and that the number of *syllables* is not the important factor. The point, however, merits much more detailed and careful study than we have accorded it here.

FACTORS LIMITING THE EXTENT OF ERROR

In examining and analyzing the great number of misspellings produced by our children, we saw that these misspellings were by no means absolutely 'wild' and uncontrolled. In other words, there was decidedly *a limit to error*. For example, when the word 'catalogue' was pronounced to be recalled, no child misspelled it

'dopintrkvxtsawltny', and no child misspelled it 'cl' or 'sg' It was misspelled 'catalouge', 'cataloge', 'catyear', 'catolague', 'catalgue', 'catologue', 'catalog', and 'catato' by our poor spellers, respectively, from which we see that the various errors occurred within rather narrow limits. For example, the initial letter is invariably 'c'; the whole initial syllable is, in fact, correctly reproduced in all cases; the number of letters used is in no case less than six, and in no case greater than nine; in only one case ('catyear') are letters introduced that are not included as an integral part of the correctly spelled word.

The word 'gymnasium' was misspelled by our children as 'gymnasuim', 'genyanation', 'gymna', 'gimnasuim', 'jimaseum', 'gymnazam', 'gymnaisum', 'jymnasium', and 'gymnazium', but no child made any such bizarre misspelling as 'whinkydoflinowd' or 'snf' The initial *sound* is reproduced in all cases, and the initial letter in all but two cases; in the majority of cases the final letter is present; in five cases out of nine, the misspellings contain the same number of letters as the correct spellings; and in the remaining cases the variation from the prescribed number of letters is very slight, except in the case of 'gymna' (where the spelling is apparently uncompleted).

The word 'customer' was misspelled as 'costminer', 'coustomer', 'cutomer', 'custona', 'coustom', 'contons', 'conster', 'costomer', 'costumer', 'costermer', and 'custumer' At a glance it is evident that the extent of error is very much limited. The initial letter is present in all cases; the final letter is present in nearly all cases; only three letters not included in the proper spelling are included in the total of misspellings; the number of letters forming the misspelled words is in no case less than seven or more than nine (the number of letters in the correct spelling being eight); in every case there is a 't' sound indicated toward the center of the word.

From such cursory inspections of the data we were led to believe that the length of words, and the prescribed letters composing the correct spelling of words are among the chief influences limiting error; and it appeared also that the influence of any letter varies greatly with its position in the word. We therefore formulated the following questions:

1. What is the average deviation from the correct number of letters, among misspelled words?

2. Is there a constant tendency to make the misspellings too short? To make them too long? In other words, is there a constant error in the length of misspellings?

3. What proportion of misspelled words contain 'foreign' letters? That is, what proportion of misspellings show letters not included *at all* in the correct spelling?

4. What is the percentage of error as related to the *position* of the letter in the word?

5. Do the extremely poor spellers among our children show the same tendencies in these particulars as are shown by the rest of the group, excluding them?

In order to answer these questions, it was decided to limit the inquiry to words of six letters and words of seven letters. A number of class exercises containing misspelled words were selected, and the work of P. J., M. S., and M.G., the three extremely poor spellers of the class, was separated from the rest and laid aside. The exercises were then inspected, and all misspelled words of six letters and of seven letters were copied in lists (separately). When the lists contained between thirty and forty misspellings each, the letters in each misspelling were counted, and the deviations from the prescribed number of letters were found. Thereupon the Average Deviations for misspellings of six- and of seven-letter words were calculated, and the amount of the Constant Error was found. The number of misspellings containing 'foreign' letters was also ascertained. The results of all these calculations are given in Table XIII and Table XIV.

In tabulating the number of errors made in letters according to position in the word, the procedure was as follows:

(*a*) Letters were counted *from both ends* of the misspelled word, in determining the position of each letter. For example, take the misspelling 'r-e-g-o-d' for 'r-e-g-a-r-d'. Here we have a deviation of —1 letter, and also an erroneous letter introduced. How shall we determine which letters are to be scored 'right' according to position, and which are to be scored 'wrong'? If we count from right to left, beginning with 'd', we shall have only one letter (the sixth) scored as 'right'. This is obviously unfair and absurd, for if we count from left to right, we shall score the first, second, and third letters as 'right'. Counting from both ends, we get the first, second, third, and sixth letters 'right', and the fourth and fifth as 'wrong'.

(*b*) But in case of double letters, one of which is omitted, the difficulty arises of deciding which element is to be scored as 'right'. For example,

take the misspelling 'c-h-o-s-e' for 'c-h-o-o-s-e' Counting from left to right, we get the third element as 'right', and the fourth element as 'wrong' Counting from right to left, we get the fourth element as 'right' and the third element as 'wrong' The solution of this difficulty was found by counting half of these cases as 'right' from the left, and half as 'right' from the right.

(*c*) Errors are of three general kinds: errors of substitution, where a letter is displaced by an erroneous letter, e.g., 's-e-v-e-r-e-l' for 's-e-v-e-r-a-l'; errors of omission, where the letter is simply left out entirely, e.g., 's-c-o-n-d' for 's-e-c-o-n-d'; errors of redundancy, where too many letters are included, e.g., 'h-u-s-d-b-a-n-d' for 'h-u-s-b-a-n-d'. According to our method of counting, errors of omission and of substitution may occur together in a given misspelling; errors of substitution and of redundancy may occur together in a given misspelling; but errors of omission and of redundancy may not occur in the same misspelling. For example, take the misspelling 'f-o-u-r-t-a-i-n' for 'f-o-r-t-u-n-e'. Here we do not say that the third element has been added, and the seventh element omitted. Counting from both ends, we say that the third element is redundant, and that the fifth, sixth, and seventh elements are 'wrong'. This method of counting in such cases is somewhat arbitrary, but was, on the whole, the best that could be evolved.

(*d*) In counting, no distinction was made between errors of omission and errors of substitution. No matter whether a letter was omitted, or supplanted by another and erroneous letter, it was scored simply as 'wrong' Take, for example, the two misspellings 't-r-u-b-l-e' and 't-r-a-u-b-l-e' for 't-r-o-u-b-l-e' In both instances the third element is scored simply as 'wrong', though in one case the 'o' is left out, and in the other it is supplanted by an 'a'. No doubt these errors are unequal. That is, if we could make a very minute psychological study of the situation, we should find that these two errors, though both 'wrong', are not equally 'wrong'. To carry the point still farther, we should find that of two errors, both of substitution, one might be more 'wrong' than the other. Very few persons, for instance, would judge that to misspell 'feature' as 'f-e-i-t-u-r-e' is as 'wrong' as to misspell it 'f-i-g-t-u-r-e'. Into these finer analyses the present study did not enter. Our point here was simply to ascertain the frequency of error of whatever kind, as conditioned by the *position* of letters in words.

(*e*) In the case of redundant elements, these were classified as to position by counting from both ends. Take, for example, the misspelling 'T-h-u-e-s-d-a-y' for 'T-u-e-s-d-a-y'. Counting from left to right, the first element is 'right'. Counting from right to left, the seventh, sixth, fifth, fourth, third, and second elements are 'right' This leaves the 'h' as an intruder, between the first and second elements. The position and frequency of these redundant letters was tabulated in every case, as it is interesting to determine which are the weak bonds that permit erroneous elements to intrude themselves into the word.

When the misspellings of the group (exclusive of P J., M. S., and M. G.) had been tabulated, the exercises of these three children were inspected, and tabulation of their errors, for each child separately, was made in exactly the same way as for the group. Table XIII and Table XIV show all these calculations, also.

From Tables XIII and XIV it is evident that the length of words is a very strong limiting influence on error. The Average Deviation from the correct length of six-letter and seven-letter words is very small, being in all cases less than one letter. There is a small Constant Error in the direction of shortness. The children tend to make their misspellings too short rather than too long.

The particular letters used in the correct spelling of a word constitute a fairly strong limiting influence on error. The tables show that more than half of the misspellings are composed exclusively of letters which are properly to be included in the correct spelling.

The influence of the letters over error varies greatly with their position in the word. With respect to position, it is clear that the initial letter is a very strong limiting influence in both six-letter and seven-letter words. The first half of the word shows a decided advantage over the last half of the word, with respect to liability to error. The bonds formed in the learner's consciousness with the first elements are very much stronger than those formed with the last elements. This advantage of initial elements over final and intermediate elements is not a function of the shape or sound of the particular letters used in the particular words here considered, as is shown by the fact that the same letters which in one word were in the first half, were in the last half in other words. The letters of the alphabet occurred as first, second, third, fourth, etc., *by chance* only.

In the six-letter words, the redundant letters intrude most often between the fourth and fifth letters, and at the very end of the word, following the sixth letter. In the seven-letter words, the redundant letters are found most often between the fourth and fifth, and between the fifth and sixth letters. Redundant elements intrude less often in the first half of words than they do in the last half.

Tables XV and XVI, derived from Tables XIII and XIV, show the percentage of error for each letter according to position, in six-letter words and in seven-letter words. Thus, for example, in the

TABLE XIII

Showing A. D. and C. E. for Length of Misspellings of Six-Letter Words; Number of Misspellings Containing 'Foreign' Letters; and Number of Errors Made in Each Letter (with Redundant Elements) According to Position

Name	*Number Words*	*A. D.*	*C. E.*	*Number Words Including 'Foreign' Letters*	*Errors Made in Each Position (With Redundant Elements)*													
					R	*First*	*R*	*Second*	*R*	*Third*	*R*	*Fourth*	*R*	*Fifth*	*R*	*Sixth*	*R*
Group	34	.60	−.12	17	0	2	0	6	4	3	2	10	0	11	0	8	3
P. J.	30	.70	+.10	15	0	2	1	6	0	6	2	15	3	16	1	12	2
M. S.	44	.48	—.39	16	0	4	1	20	0	19	0	29	1	20	0	15	1
M. G.	35	.66	−.37	15	0	0	0	5	0	8	1	16	3	18	0	13	1

TABLE XIV

Same Data for Misspellings of Seven-Letter Words

Name	*Number Words*	*A. D.*	*C. E.*	*Number Words Including 'Foreign' Letters*	*Errors Made in Each Position (With Redundant Elements)*														
					R	*First*	*R*	*Second*	*R*	*Third*	*R*	*Fourth*	*R*	*Fifth*	*R*	*Sixth*	*R*	*Seventh*	*R*
Group	36	.56	−.03	23	2	1	1	1	0	3	2	13	1	15	2	16	0	10	2
P. J.	30	.80	−.53	13	0	1	0	7	1	11	1	9	0	13	0	13	0	14	1
M. S.	37	.73	−.57	11	0	0	1	6	0	10	0	15	1	9	0	9	0	12	0
M. G.	34	.56	−.21	12	0	0	0	5	1	7	0	8	3	10	3	10	2	9	0

case of six-letter words, the group made errors in 6 per cent. of first letters, in 18 per cent. of second letters, in 9 per cent. of third letters, etc. The curves in Fig. 4 are platted from these tables.

TABLE XV

Showing Per Cent. of Error for Each of Six Letters, According to Position

Name	*Number of Words*	*Per Cent. of Error for Each of Six Letters, According to Position*					
		1	*2*	*3*	*4*	*5*	*6*
Group	34	6	18	9	29	32	21
P. J.	30	7	20	20	50	53	40
M. S.	44	9	45	43	66	45	34
M. G.	35	0	14	23	46	51	37

TABLE XVI

Showing Per Cent. of Error for Each of Seven Letters, According to Position

Name	*Number of Words*	*Per Cent. of Error for Each of Seven Letters, According to Position*						
		1	*2*	*3*	*4*	*5*	*6*	*7*
Group	36	3	3	8	37	42	44	28
P. J.	30	3	23	37	30	43	43	47
M. S.	37	0	16	27	41	24	24	32
M. G.	34	0	15	21	23	30	30	26

In words of six letters, the fourth and fifth letters have least influence over error. They are more likely to be 'wrong' than any other letters. The sixth letter is next in order of liability to error. The second and third letters come next, and are about equally liable to be 'wrong' The first letter is by far the least likely to be 'wrong', of all letters in the word.

In words of seven letters, the fifth and sixth letters are weakest in their influence over error. The fourth and seventh letters are about equal in strength, and stand next in liability to error. The third letter is considerably weaker than the second, here, and stands

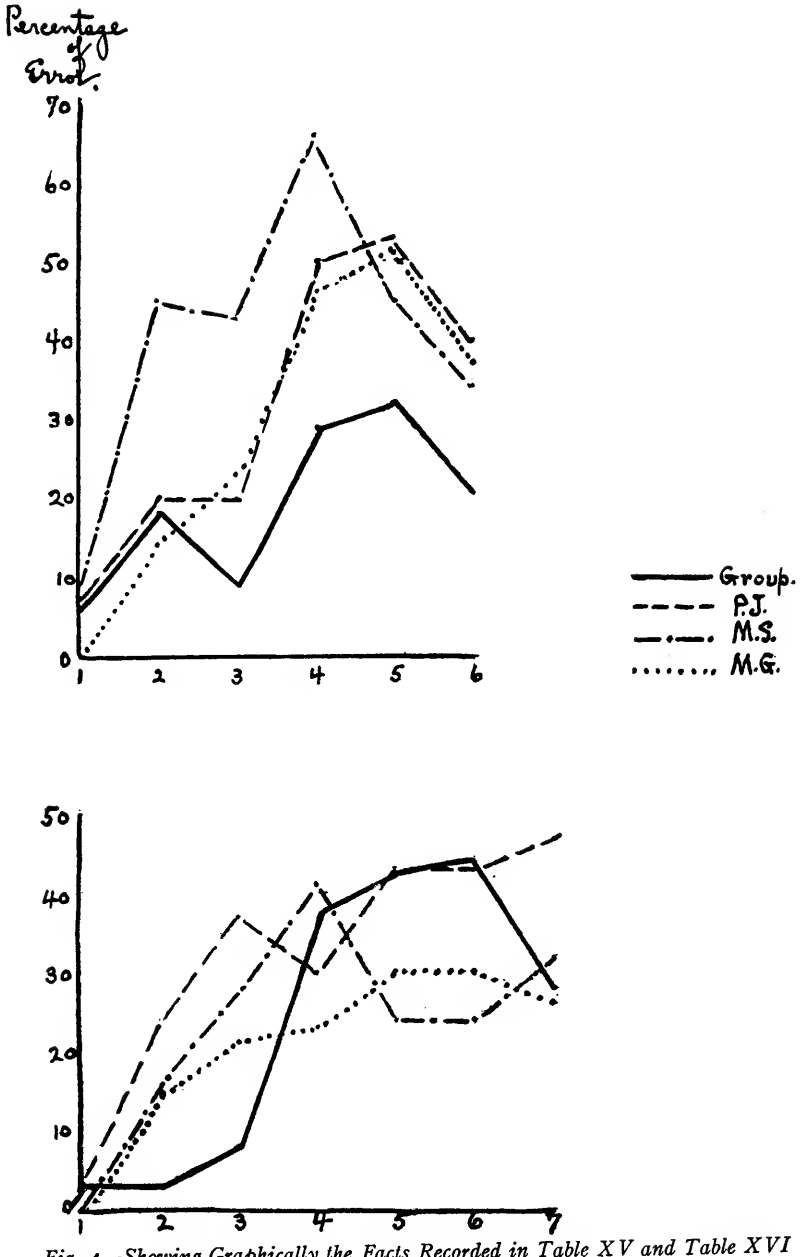

Fig. 4—Showing Graphically the Facts Recorded in Table XV and Table XVI

next to the fourth and seventh. The second letter shows relatively little liability to error; while the first letter is almost never 'wrong'

Thus we find that the curves for six-letter and for seven-letter words follow the same laws: (1) The first letter is in all cases the strongest limiting influence over error. (2) The second and third letters are, on the average, next to the first in strength. (3) The final letter stands, on the average, next to the second and third letters in its power to limit error. (4) The two letters preceding the final letter are most at the mercy of error. The bonds controlling them are weakest and most difficult to form. They are not only more often 'wrong' than any other letters, but they also are more likely to permit of the intrusion of redundant letters than are any other letters of the word.

Of special interest to us is the fact that the three extreme cases of poor spelling show the same tendencies shown by the group which does not include them. Their errors are not different in kind, but only in quantity. P. J., M. S., and M. G. make *many more* errors than do other children in the class, but when an equal number of their errors and of the errors of better spellers are analyzed and compared, the resulting curves of error show the same trends for them as for others. They, like others, are greatly influenced by the *length* of words, the Average Deviation from the prescribed number of letters being for them only slightly greater than for others. Their Constant Error is in the direction of making the word too short, just as is the case with others. Their misspellings, like those of others, are made up in the majority of instances from letters that form an integral part of the correct spelling. Like others, they almost invariably get the first letter 'right', and are weakest on the two letters which precede the final letter.

All the differences which are discoverable from this analysis between the three extreme cases and the others, are differences of degree and not of kind. The poorest spellers simply make *more* errors than the others make. As the experimental teaching progressed, P. J., M. S., and M. G. made about half of all the errors made by the class; that is, these three children together made as many errors as did the remaining eleven members of the class together. Inspection of the tables also shows that these three children are much more likely to have *several letters* wrong in a single misspelled word than is the case with the others. M. G.,

for example, makes many more errors in fourth and fifth letters of six-letter words than in any other letters of such words, just as the group does; but *nearly half* of all her misspellings contain errors in these places, while *scarcely a third* of the group's misspellings contain errors in these places. She makes *many more* errors of the *same kind* as those made by the group.

It also appears that the influence of second letters and of final letters is not absolutely so great on the poor spellers as it is over the others. The influence of these elements on the poor spellers is *relatively* the same as for the others, so that the curves follow the same trend; but the poorest spellers 'go to pieces' a greater number of times on second and on final elements than the others do. *Though controlled by the same factors, the poorest spellers are less firmly controlled than are the others.*

KNOWLEDGE OF MEANING AS A DETERMINANT OF ERROR

As heretofore indicated in our discussion, Smedley suggested several years ago that there might be a 'rational element' in good spelling, whereby knowledge of the *meaning* of words would contribute to the correct spelling of them, in and of itself. In order to test this suggestion experimentally, we pronounced a list of thirty words to our children, with the following preliminary instructions:

> Now, I am going to pronounce some words to you, one at a time. When I pronounce a word you must spell it, and then underneath the spelling you must use the word in a sentence, so I can see whether you know what it means. Do you all understand? All ready, now: The first word is 'guess'. First spell it, and then write a sentence with 'guess' in it, so I can see whether you know what it means. Be sure to do your very best.

The teacher thereupon proceeded with all the other words in the list, pronouncing each as often as was necessary to satisfy every child. No data concerning any word were given other than the pronunciation of it. The list was selected at random from available lists. The words were:

LIST I

guess	official	impossible	distinguish	probably
circular	victim	concern	consideration	foreign
argument	estimate	associate	colonies	expense
volume	accident	meant	assure	responsible
organize	invitation	earliest	relief	beginning
summon	accept	whether	occupy	application

The performance of each child in *spelling* each word and showing knowledge of its *meaning* was then tabulated. Every word in the list was spelled correctly by *some* of the children, and every word was used correctly by *some* of them. *Any* error in spelling was counted as a misspelling, and was given a red mark, regardless of its kind or amount; and *any* failure whatsoever to use the word in a sentence in such a way as to produce good sense was counted an error in knowledge of meaning, and was given a blue mark. Tables XVII and XVIII are derived from these data.

In Table XVII we sought the answer to this specific and definite question: *Will our children show a greater proportion of misused words among their misspelled words, than among their correctly spelled words?* Obviously, if children's correctly spelled words are as often misused as are their misspelled words, there is no relation between knowledge of meaning and correct spelling. Furthermore, the influence of knowledge of meaning as a determinant of error will be in proportion to the difference between 'Misspelled and Misused' and 'Correctly Spelled and Misused' If the first column in Table XVII should, for example, average 100 per cent., while the second column averaged 0 per cent., ignorance of meaning would be shown to be an inevitable accompaniment of error in the spelling of these words.

Inspection of Table XVII, List 1, shows that *the percentage of misuse is decidedly greater among misspelled words than among correctly spelled words; and that this is true not only of the average, but for every individual child, with the single exception of L. K.*

In order to verify our result, we repeated the test one month later, exactly as before, but using a different list of words, as follows:

LIST 2

automobile	recent	conference	develop	senate
various	business	Wednesday	circumference	receive
decide	refer	really	issue	respectfully
entitle	minute	difficulty	material	agreement
political	ought	scene	suggest	unfortunate
national	absence	finally	mere	majority

The data thus obtained were tabulated exactly as before, and the result appears in Table XVII, under List 2. The result, as may be seen from inspection, verifies the findings of the first test.

The percentage of misuse among misspelled words is decidedly greater than the percentage of misuse among correctly spelled words; and this holds true not only for the average, but for every individual child, without exception. The ratio of 'Misspelled and Misused' to 'Correctly Spelled and Misused' is constant—1.7 to 1 for List 1, and 1.8 to 1 for List 2.

TABLE XVII

Showing Per Cent. of Misspelled Words Misused, as Compared with Per Cent. of Correctly Spelled Words Misused, for Each Child (Lists 1 and 2)

Name	List 1		List 2	
	Per Cent. Misspelled and Misused	*Per Cent. Correctly Spelled and Misused*	*Per Cent. Misspelled and Misused*	*Per Cent. Correctly Spelled and Misused*
H. A.	53	40	25	18
M. G.	41	33	59	12
R. H.	80	76	100	80
P J.	72	0	71	50
L. K.	33	40	45	21
H. L.	62	33	83	75
R. L.	50	27	14	9
B. N.	38	29	57	35
J. P.	50	42	33	8
H. R.	100	23	64	31
S. Sc.	50	18	25	14
M. S.	53	50	52	0
S. Sh.	39	33	33	6
M. U.	50	37	65	43
Av.	*55*	*34*	*52*	*29*
A. D.	*13*	*11*	*19*	*20*

In Table XVIII we sought the answer to this specific question: *Will our children show a greater proportion of misspellings among their misused words than among their correctly used words?* This question is not, as might seem at first glance, merely the reverse of that asked in Table XVII. Table XVIII cannot be derived from

Table XVII. To illustrate: In List 1, R. H. misspelled 5 of the 30 words, but he misused 23; he *both* misspelled and misused 4 words of the 30. It follows that he misspelled but 17 per cent. of his misused words, but that he misused 80 per cent. of his misspelled words. Table XVIII gives us a valuable check on Table XVII, for it might be that children can use words which they cannot spell correctly, better than they can spell words which they cannot use correctly.

TABLE XVIII

Showing Per Cent. of Misused Words Misspelled, as Compared with Per Cent. of Correctly Used Words Misspelled, for Each Child (Lists 1 and 2)

Name	List 1		List 2	
	Per Cent. Misused and Misspelled	*Per Cent. Correctly Used and Misspelled*	*Per Cent. Misused and Misspelled*	*Per Cent. Correctly Used and Misspelled*
H. A.	57	38	33	25
M. G.	92	83	93	68
R. H.	17	14	35	0
P. J.	100	50	84	54
L. K.	46	37	56	29
H. L.	88	61	63	33
R. L.	22	10	33	19
B. N.	60	50	33	17
J. P	23	18	33	7
H. R.	62	0	64	31
S. Sc.	70	35	40	24
M. S.	82	77	100	80
S. Sh.	64	52	80	32
M. U.	79	50	83	67
Av.	*62*	*41*	*59*	*35*
A. D.	*21*	*19*	*22*	*18*

We learn from inspection of Table XVIII that *the percentage of misspelling among misused words is decidedly greater than among*

correctly used words; and that this holds not only for the average, but for every individual child, without exception, both in List 1 and in List 2. We learn, furthermore, that the ratio of 'Misused and Misspelled' to 'Correctly Used and Misspelled' is nearly constant—1.5 to 1 for List 1, and 1.7 to 1 for List 2.

On the basis of these data we conclude that *knowledge of meaning is probably in and of itself an important determinant of error in spelling; that children will produce about sixty-six and two-thirds per cent. more of misspellings in writing words of the meaning of which they are ignorant or uncertain, than they will produce in writing words the meaning of which they know.* It is interesting to note here that 'spell' is derived from the ancient word 'spellian', *to tell*, that is, *to convey meaning.*

Knowledge of meaning is, of course, very far from being the sole determinant of error. Children spell correctly dozens of words which they cannot define or use. In doing this they are guided by many factors—the sound of the word, the length of it, analogy with other words that resemble it, etc. For example, the word 'mere' was spelled correctly by five children who had no idea of its proper meaning or use. The opposite fact, that children frequently misspell words the meaning of which they know perfectly, is a matter of common observation in any school room. For example, the word 'invitation' was misspelled by ten of our children, all of whom knew its meaning very well, and used it correctly in sentences. The child R. H. is a peculiar and remarkable example of ability to spell words without knowing their meaning. This child misused 23 of the 30 words in List 1, but of these he spelled 19 correctly. He misused 26 of the 30 words in List 2, but of these misused words, he spelled 17 correctly! That such marked discrepancy between ability to spell and ability to use words is atypical, is shown by the fact that the correlation for the group between these two abilities is +.55 (using the formula $\rho = 1 - \frac{6\Sigma d^2}{n(n^2-1)}$, and transmuting into values of r, as in Chapter III).

We venture the suggestion that an interesting and instructive extension of this experiment would have been to take List 1, after the data here described had been obtained, and to have *taught* the words according to the method adopted by us for presenting new words (p. 16), *except* that no data should be given regarding the

meaning of the words. Thereupon List 2 might have been taken, and the *meaning also* taught. If, after this procedure, the two lists were again dictated to the children, we should see how much improvement may result from also knowing the meaning, as compared with the improvement which results from knowing everything about words *except* the meaning. This test we failed to make, but the experiment is one which might easily be undertaken.

THE CONSISTENCY OF ERROR

In repeated misspellings of the same word, do children who are poor spellers show a random use of wrong letters? Or do they consistently misspell the word in the same way, indicating that *learning* has taken place, albeit an erroneous learning?

Our results indicate that errors arise both from *the definite formation of erroneous bonds*, and from *the failure to form any definite bonds whatever*, but that the former is somewhat the more frequent source of error. The following examples will serve to illustrate both kinds of error.

1. *Errors due to the formation of erroneous bonds.* M. Gl. misspelled 'went' as 'w-h-e-n-t' consistently for eight successive times in composition, until corrected, after which she spelled it correctly. She spelled 'disgusting' (a favorite word with her) as 'd-i-s-c-o-u-s-t-i-n-g' consistently, until corrected. She misspelled 'afterwards' as 'a-f-t-e-r-w-o-o-d-s' consistently, until corrected. In all these cases, M. Gl. had learned a wrong *pronunciation* of the word. The bonds described in our analysis of the spelling process under (2) (See Chapter VIII) had been formed erroneously. When these bonds had been corrected, the child spelled the words correctly.

E. G. misspelled 'storekeeper' as 's-t-o-r-e-h-e-e-p-e-r' consistently, until corrected. Here the symbol 'k' had become confused with another visual symbol closely resembling it, and an erroneous bond had been definitely formed. This was overcome by writing the word with a large 'k' where the 'h' had formerly appeared.

H. A. misspelled 'stadium' as 'a-s-t-a-d-i-u-m-n' consistently, until corrected. When asked why he spelled it so, he replied that 'autumn' ends "just like that, or anyway it has the same sound." Asked why he began the word with 'a' he replied that the teacher called it "a stadium." Here two erroneous bonds had been definitely formed. The child had 'bound' the final 'n' to the word by reasoning from analogy with another word recently learned, i.e., 'autumn'. He had 'bound' an initial 'a' to the word through

the sentence used to clarify the meaning of the word, for instance, "There is a stadium at the City College."

2. *Errors due to failure to form definite bonds.*

M. S. misspelled 'saucer' successively as

s-a-u-e-c	s-u-s-s-e-r
s-u-s-s-e	s-u-c-e
s-u-c-c-e-r	s-u-s-s-e-r
s-u-c-c-e-r-e	s-u-c-c-e-r
s-u-r-r-e-s	

E. G. misspelled 'library' successively in class exercises as

l-a-r-b-r-a-y	l-i-b-r-y
l-a-r-b-o-y	l-i-b-e-r-e-r-y
l-a-b-o-r-a-r-y	

S. Sc. misspelled 'dictionary' successively as

d-i-c-t-i-o-n-n-a-r-y
d-i-c-t-i-o-n-r-y
d-i-c-t-o-n-e-r-y

CHAPTER VI

IMPROVEMENT IN SPELLING ABILITY AS MEASURED BY SCALES

In order to measure the possible increase in Spelling Ability after several weeks of special instruction, lists from Ayres' Scale for the Measurement of Spelling Ability were given at the beginning and at the close of each ten-week period. The First Semester Group was tested with Lists H and I, and with Lists P and O. The Second Semester Group was tested with Lists Q and R. The percentage of test words correctly spelled constitutes the record of each child. These records are as follows:

TABLE XIX

Showing Scores, and Amount of Improvement, for Instructed Groups, and Control Groups, on Ayres Lists H, I, O, P, Q, and R

List H

FIRST SEMESTER GROUP				CONTROL GROUP			
Name	*November 2*	*January 16*	*Improvement*	*Name*	*November 2*	*January 5*	*Improvement*
H. A.	94.5	98.9	4.4	B. D.	96.1	98.1	2.0
M. Gl.	92.3	92.3	0.0	B. E.	92.3	98.1	5.8
E. G.	94.2	88.5	—5.7	H. F	92.3	absent	
M. G.	92.3	86.0	—6.3	J. F	92.3	98.1	5.8
R. H.	88.0	96.2	8.2	R. G.	100.0	96.2	—3.8
P J.	86.5	94.3	7.8	D. H.	92.3	94.2	1.9
L. K.	98.1	98.9	0.8	H. H.	96.1	100.0	3.9
H. L.	94.5	98.9	4.4	L. L.	96.1	100.0	3.9
B. M.	100.0	100.0	0.0	I. N.	96.1	98.1	2.0
J. P.	98.1	100.0	1.9	S. O.	94.2	94.2	0.0
L. R.	88.5	dropped		A. S.	100.0	100.0	0.0
S. Sc.	94.5	98.9	4.4	S. St.	94.2	94.2	0.0
S. Sh.	94.5	100.0	5.5	M. T.	98.0	98.1	0.1
S. S.	100.0	98.9	—1.1	F W.	98.1	100.0	1.9

TABLE XIX (*Continued*)

List I

FIRST SEMESTER GROUP				CONTROL GROUP			
Name	*November 2*	*January 17*	*Improvement*	*Name*	*November 2*	*January 9*	*Improvement*
H. A.	98.3	95.3	—3.0	B. D.	92.0	98.4	6.4
M. Gl.	91.2	100.0	8.8	B. E.	92.0	96.8	4.8
E. G.	92.4	absent		H. F	93.6	absent	
M. G.	74.6	94.9	20.3	J. F	97.6	100.0	2.4
R. H.	92.4	98.4	6.0	R. G.	97.6	96.8	—0.8
P. J.	90.5	96.8	6.3	D. H.	92.0	82.5	—9.5
L. K.	91.9	96.8	4.9	H. H.	absent	100.0	
H. L.	98.3	98.4	0.1	L. L.	90.3	96.8	6.5
B. M.	100.0	100.0	0.0	I. N.	98.4	100.0	1.6
J. P.	98.3	95.3	—3.0	S. O.	92.0	96.8	4.8
L. R.	98.3	dropped		A. S.	96.8	100.0	3.2
S. Sc.	93.6	96.8	3.2	S. St.	absent	96.8	
S. Sh.	100.0	96.8	—3.2	M. T.	97.6	100.0	2.4
S. S.	98.3	100.0	1.7	F. W.	98.4	absent	

List O

List P

FIRST SEMESTER GROUP (NO CONTROL GROUP)

Name	*November 6*	*December 23*	*Improvement*	*Name*	*November 9*	*January 9*	*Improvement*
H. A.	89.2	94.3	5.1	H. A.	67.9	89.7	21.8
M. Gl.	75.0	91.4	16.4	M. Gl.	71.2	95.1	23.9
E. G.	72.3	96.9	24.6	E. G.	71.2	95.1	23.9
M. G.	25.0	42.9	17.9	M. G.	absent	46.7	
R. H.	86.1	absent		R. H.	81.3	98.3	17.0
P. J.	26.5	38.2	11.7	P J.	35.9	42.4	6.5
L. K.	71.5	88.6	17.1	L. K.	61.9	86.4	24.5
H. L.	58.6	74.3	15.7	H. L.	64.1	62.7	—1.4
B. M.	80.7	88.6	7.9	B. M.	83.1	86.4	3.3
J. P.	97.2	97.1	—0.1	J. P.	86.4	94.9	8.5
S. Sc.	86.1	91.4	5.3	S. Sc.	89.9	89.7	—0.2
S. Sh.	71.4	88.6	17.2	S. Sh.	74.4	84.7	10.3
S. S.	86.1	91.4	5.3	S. S.	83.1	91.4	8.3

TABLE XIX (*Continued*)

List Q

SECOND SEMESTER GROUP				CONTROL GROUP			
Name	*February 6*	*April 26*	*Improvement*	*Name*	*February 11*	*April 27*	*Improvement*
H. A.	81.9	77.0	—4.9	D. H.	24.3	32.4	8.1
M. G.	25.7	40.6	14.9	H. H.	98.6	95.9	—2.7
R. H.	95.4	93.2	—2.2	J. F.	87.8	98.6	10.8
P J.	33.8	43.2	9.4	B. D.	95.9	97.3	1.4
L. K.	73.2	89.2	16.0	S. O.	68.9	75.7	6.8
H. L.	56.8	67.6	10.8	H. D.	89.2	100.0	10.8
R. L.	82.5	97.3	14.8	I. N.	91.9	89.2	—2.7
B. N.	86.4	94.6	8.2	S. S.	90.5	97.3	6.8
J. P.	94.6	98.6	4.0				
H. R.	81.1	91.9	10.8				
S. Sc.	75.7	94.6	18.9				
M. S.	22.9	51.4	28.5				
S. Sh.	81.1	87.9	6.8				
M. U.	absent	59.4					

List R

SECOND SEMESTER GROUP				CONTROL GROUP			
Name	*February 15*	*April 27*	*Improvement*	*Name*	*February 13*	*April 26*	*Improvement*
H. A.	82.1	85.7	3.6	D. H.	26.7	37.5	10.8
M. G.	23.2	37.5	14.3	H. H.	76.7	89.2	12.5
R. H.	92.9	91.0	—1.9	J. F.	85.7	absent	
P. J.	24.9	28.6	3.7	B. D.	89.2	94.6	5.4
L. K.	75.0	83.6	8.6	S. O.	39.2	64.3	25.1
H. L.	58.9	52.5	—6.4	H. D.	82.1	85.7	3.6
R. L.	85.8	94.7	8.9	I. N.	91.0	92.9	1.9
B. N.	89.3	98.2	8.9	S. S.	85.7	94.6	8.9
J. P.	94.7	92.8	—1.9	I. K.	96.4	98.2	1.8
H. R.	75.0	76.8	1.8				
S. Sc.	75.0	absent					
M. S.	32.1	30.0	—2.1				
S. Sh.	69.7	73.2	3.5				
M. U.	absent	54.6					

From these figures we see that those children who stood low in the first tests show larger percentages of improvement, on the whole, in the second tests than did those who stood high in the first tests. This is almost certainly because those who measured high in the first tests, for example above 95 per cent., had very little *chance* to improve, being almost at perfection on the first trial. The limit of ability is set at 100 per cent., so that no true comparison can be made, according to this method, between the excellent spellers and the very poor spellers. The poorest spellers of the Experimental Class, P. J., M. S., and M. G., improve as the others do when measured by the scale, but they do not improve their relative position in the group. They improve somewhat upon their own records, but still retain the lowest positions among their fellows.

During the weeks of special instruction in spelling given to the Experimental Class, the Control Group (studying arithmetic) had no special instruction whatever in spelling. No extra attention of any kind was paid to spelling in this group. The children took the spelling tests at the time they were given to the Spelling Class. The school work of the two groups then went on uniformly, except that one group had one hour daily of special instruction in spelling, while the other had no special work in spelling (but had one hour daily of special instruction in arithmetic).

The Control Group thus gives us a check on any conclusion about improvement due to special instruction in spelling, as shown by the spelling scale. *The figures tell us that the children of the Control Group improved as much as did the children of the specially instructed group, in those cases where the individuals were equally far from perfection to begin with.* The average amount of improvement for each group on each list is as follows:

Instructed Groups			Control Groups		
	Average	*A. D.*		*Average*	*A. D.*
Ayres H	+1.9	3.6	Ayres H	+1.8	1.9
Ayres I	+3.5	4.7	Ayres I	+2.2	3.0
Ayres Q	+9.7	6.4	Ayres Q	+4.9	4.7
Ayres R	+3.4	4.6	Ayres R	+8.5	4.8

We must conclude, therefore, that the improvement which our poor spellers showed on the scale was due, not to our special efforts, but to factors in the environment of all the children, which acted upon the Control Group as well as upon the Spelling Group. Apparently, it was impossible for us to increase these children's Spelling Ability, as measurable on the Ayres Scale, by giving fifty extra hours of special instruction in spelling—an amount of time and effort equivalent to that spent in the public schools on spelling during a period of about eight months.

Does this mean that after the fifty hours of labor spent by our children, they were no more able to communicate by means of correctly spelled words than at the beginning of the period of instruction? Such an inference would obviously be absurd and unjustified by the facts. Our children learned to spell scores of words, which they could not spell when they entered the class, and which they did not learn elsewhere. *They formed hundreds of specific bonds*, which were not formed by the children of the Arithmetic Class. Why, then, do they not show a gain over their uninstructed fellows, when re-measured on the spelling scale? And in just what sense can an instrument that does not show the increment due to these specific bonds, be called a scale for the measurement of spelling ability?

We believe that the character of English spelling renders impossible the use of a scale for the measurement of Spelling Ability in just the same sense that a scale for the measurement of Arithmetical Ability can be used. In such scales as the Woody[1] Arithmetic Scales, the increase in ability to perform arithmetical processes correctly, due to fifty hours[2] of special instruction, is measurable, *because such ability does not depend on the formation of hundreds of specific bonds, but on the formation of comparatively few fundamental bonds, which operate throughout.* To divide 78 by 23 helps the pupil to divide 68 by 13. To multiply 427 by 69 helps the pupil to multiply 785 by 84. To subtract 193 from 342 helps in subtracting 247 from 986. The following tabulation shows the average improvement (in points) of the group instructed in the four fundamental processes of arithmetic, as compared with their control group,

[1] Woody, Clifford, Measurements of Some Achievements in Arithmetic, Teachers College Contributions, No. 80, 1916.

[2] The fifty hours were equally divided among the four fundamental operations, so that but about twelve hours were actually given to drill in each of them.

when measured by the Woody Scales before and after special instruction.

Instructed Group			Control Group [3]		
	Average	*A. D.*		*Average*	*A. D.*
Woody—Add. B.	+13	36	Woody—Add. B	−38	36
Woody—Sub. B	+47	56	Woody—Sub. B	−4	32
Woody—Mult. B	+48	39	Woody—Mult. B	+0.6	44
Woody—Div. B	+42	52	Woody—Div. B	−2	17

In spelling, however, the situation is psychologically very different. To learn to spell 'collar' does not help much in spelling 'column' or 'color' To learn 'autumn' does not help in spelling 'stadium' To learn 'clear' does not help to spell 'hippopotamus' Attempt to 'transfer' what has been learned in spelling 'collar' to the spelling of 'color' is harmful rather than helpful to the child being tested, for he is marked 'wrong' if a single element in his spelling is erroneous. In a sense, it is positively harmful for the child being tested with the word 'eight', to have learned 'late' and 'gait'

English spelling must be acquired by the formation of hundreds of specific bonds, and cannot be acquired by the formation of a comparatively few fundamental bonds. If a child has not formed the specific bonds involved in spelling 'eight', there is no help (and may be positive hindrance) for him in the possession of a thousand other words. But if a child, who knows his tables, has learned to multiply 526 by 373, he is greatly assisted in multiplying any three-place number by any other three-place number, so long as the multiplier does not contain a 0. Where a given degree of Arithmetical Ability calls for the formation of a score of various bonds, a like degree of Spelling Ability will call for the formation of hundreds.

It is, therefore, psychologically impossible to measure increments of Spelling Ability, due to general instruction over a period of

[3] The fact that the control group here makes no improvement whatever, though studying arithmetic in their regular work in the public school, is explained by us on the ground that the school work in arithmetic was with 'problems', and afforded no systematic drill in the four fundamental operations.

weeks, by means of the Ayres Measuring Scale. In order to increase a child's ability to spell the test words on this scale he must be taught those specific words; *must form those specific bonds.* It should be clearly understood that these facts do not detract in the least from the value of the scale as an instrument for measuring the knowledge of spelling of the school children in the public schools. Such children are able to spell the test words 'proper' to their grade because they have, in the course of events, learned to spell *those specific words*, if they are of the intellectual level which is average for that grade. Not to be able to spell the fifth grade list in the fifth grade is a sign of inferiority or eccentricity either in the pupils or in the instruction given, because the content of the curriculum, and the life experience of an average fifth grade child, are such that *the very words* of the test list are learned by him, and are thus found by scientific investigation to constitute 'the norm' for fifth-grade children.

What, now, were these 'factors in the environment' which we said all the children of our two groups (Spelling and Control) had in common, and which produced improvement [4] in the children who had no special instruction in spelling equal to that in the children who had such instruction? We believe that these factors were the reading, geography, arithmetic, language and spelling lessons, which *all* fifth grade children study in common, according to the prescribed curriculum for children of that school status.

We, for instance, taught the children of the Experimental Class to spell words of various categories—the names of all animals, of all birds, of all flowers, of all coins, of all occupations. The many bonds thus formed by the children were probably of almost zero effect in raising their status on the Ayres Spelling Scale, for inspection of Lists H, I, O, P, Q, and R shows an almost complete absence of such words. To press the point by means of a somewhat absurd illustration, it is likely that fifty hours spent in learning to spell the surnames of all the country gentlemen in England would have but very slight effect in raising the rating of a fifth grade child on the Ayres Spelling Scale.

In closing this discussion, one further point merits attention. We found, in Chapter IV, a positive correlation of .818 between the ranking of children on the Ayres Scale and their ability to

[4] As measured on the Ayres Scale.

recall new words, specifically taught; and a positive correlation of .735 between ranking on the Ayres Scale and ability to *recognize* new words, specifically taught. There is thus a high positive correlation between ability to have formed the bonds requisite for correct spelling of the Ayres lists, and ability to form *new* bonds requisite for the correct spelling of a given list of new and unfamiliar words, e.g., the names of all flowers. The child who stands low on the Ayres Scale will be very likely to learn the *new* words slowly and with difficulty. The success with which a child has formed 'spelling bonds' in the past is a clue to the success with which he will form them in the future. In this sense, also, the Ayres Scale affords a measure of Spelling Ability.

CHAPTER VII

REMARKS ON INDIVIDUAL CASES

At the end of the experiment, we made a brief summary of the case of each individual child who had been under our instruction and observation, noting his general intelligence; his ability to spell; whether he was in reality a case of special disability in spelling; if not, the reasons why he had appeared to be so; peculiarities of temperament; speech defects; and any miscellaneous points which seemed to bear upon our experimental interests. Such summaries are the following, in alphabetical order:[1]

1.

H. A. A boy, twelve years and two months old, of average intelligence. A careful, well-balanced, responsive child. Born in the United States, and started to public school at the average age. Was under hospital treatment for asthma for one year, and on this account is retarded in school grading by about one year. He is graded below his mental level in public school, being in 5B when mentally be belongs in 6B. Not an extreme case of special disability in spelling. He learns spelling lessons with fair facility. He *writes* badly, but spells fairly well when he recites orally, or when he takes special pains with his *writing*. An idiosyncrasy for adding final 'e' to words is also responsible for many of his blunders, (See p. 41).

2.

M. Gl. A girl, ten years and four months old, of normal intelligence. Born in the United States, and entered public school at the average age. Was 'left back' once, and 'skipped' once, in school, and is thus now at the norm in school grading, according to the age-grade standards (in 5A). A very difficult child to manage. Has constantly to be reprimanded. (Finally dropped from the class in the second semester, because it took too much of the teacher's time to discipline her.) Not a case of special disability in spelling, but a case of indifference and carelessness. When working for a prize can learn with facility. She has a decided lisp in speaking.

[1] Figures showing Mental Level, Intelligence Quotient, and Spelling Ability, as quantitatively measured, are given in Chapter III, for each child.

3.

E. G. A boy, eleven years and ten months old, slightly below the average in general intellectual ability. Born in the United States, and entered public school at the average age. Was 'left back' one half year, and is now in Grade 5A. A very anaemic child, under treatment for an affection of the skin, which was the cause of his dropping out in the second semester. Also somewhat myopic. Enthusiastic, and puts forth great effort in competitive tasks. Is careless about spelling, when no prize is involved. Learns with fair facility when properly motivated.

4.

M. G. A girl, eleven years and four months old, of good average intelligence. A 'boss' among the other children. Born in the United States, and entered public school at the average age. Has been promoted regularly, in spite of her extremely poor spelling, and is now in 5B. Has strong competitive tendencies, but never earns any rewards, because she is always among the poorest spellers in whatever task is undertaken. Her teacher describes her as "hopelessly below par in spelling." This child is one of those who can be properly classified as a case of special disability in spelling. General intelligence is good, and ability in other school subjects, except reading, is good. She is a native child, who has been in school regularly, and hence her poor spelling cannot be ascribed to unfamiliarity with the English language. She has no sensory defects. She is not timid. (See samples of M. G.'s spelling, p. 77.)

5.

R. H. A boy, twelve years and five months old, very decidedly below the average in general intelligence. Case of a dull child who is a very good 'mechanical' speller. His teacher rated him as a poor speller, and we explain this estimate by the fact that he is very dull in general, and does not know the meaning of the words he spells; for this reason, he often confuses homonyms, and produces odd errors when writing from dictation, or doing written lessons. He is as good at learning words in columns as is J. P. or S. S., both of whom are of more than average intelligence and who are also good spellers. Born in the United States, and has attended public school since the age of six years. Has been 'left back' twice, and is now in 5B, a year retarded in school grading.

6.

P. J. A girl, eleven years and five months old, of normal intelligence. Born in the United States, and has attended public school for five years.

Now in 5B. This child may properly be described as a case of special disability in spelling. Her spelling is practically unintelligible, except when the words spelled have been carefully, specifically and recently studied by her. About matters in general, she is not at all stupid. Effort is very good. She enters each new contest for reward with hope and enthusiasm, but cannot succeed. She has a speech defect—stammers slightly when she reads or spells aloud, and will not participate in oral spelling 'matches' Her case suggests that the spelling ability of children with speech defects might possibly repay study. (See samples of P. J.'s spelling, p. 77.)

7.

L. K. A boy, twelve years and five months old, of inferior general intelligence. Born in the United States, and entered public school at the normal age. Repeated at least once, and is now in 6A (second semester). Very polite, obliging, docile child. Puts forth good effort, and learns as well as one would expect a child of his intelligence quotient to learn. Cannot be described as case of special disability in spelling.

8.

H. L. A boy, twelve years and six months old, of inferior general intelligence. No information as to place of birth. Is now in Grade 6A (second semester). Such disability as he shows is undoubtedly general rather than special, as he does poorly in all tests, both of intelligence and of school work.

9.

R. L. A boy, twelve years and no months old, of superior intelligence. Born in the United States, and entered public school at the normal age. Now in 6A (second semester). Child is a good speller, and is recognized as such by his teacher. He requested the privilege of attending the Experimental Class, started in on his own initiative, and was allowed to continue. A good speller throughout.

10.

B. M. A girl, eleven years and nine months old, of average intelligence. A good 'personality' Large, well-grown, well-controlled child, who inspires confidence, and is oftenest sent by the teacher when errands are to be done. Seems to have a 'mind set' for spelling, so that when spelling words in a column, i.e., *doing a spelling lesson*, she spells correctly; but when writing general communications her spelling deteriorates, and she misspells many words. To this fact we ascribe the statement of her teacher that she is a

poor speller. She cannot be described as a case of special disability in spelling, as she forms all bonds involved in spelling quickly and correctly when 'doing a spelling lesson' Born in the United States. Promoted regularly in public school. Now in 5A.

11.

B. N. A girl, nine years and eleven months old, of average intelligence. Born in the United States, and attended public school. Is now repeating Grade 5A. Both her actual age and her mental age are those proper to Grade 4B. Accepted in the second semester on the judgment of the teacher, who thought her a fit subject for our class. We found no evidence of disability in spelling. The marks of B. N. on tests show, on the contrary, that she is a good speller.

12.

J. P. A boy, ten years and eight months old, of superior intelligence, the clearest, keenest mind among the children of our class, in both semesters. Born in the United States, and has attended public school for five years, being promoted regularly. Now in Grade 5B. Intellectually, he is capable of doing the work of 6B. Recommended as a poor speller by the teacher, and did poorly on preliminary tests of Spelling Ability. Is always in a hurry, asking what he shall 'do next', what 'the lesson for tomorrow' will be, etc. Is impatient with drudgery. As soon as he learned that a reward would follow excellence in spelling lessons, he fell to work, and learned spelling very easily and quickly. J. P. is, in fact, a very good speller, *when to spell correctly brings him a reward which is valuable to him.* He became indeed something of a problem in class management, as he was able to learn all of the material presented before the other children were fairly started on the task, and extra material had constantly to be prepared for him.

13.

H. R. A boy, eleven years and six months old, of intelligence so inferior as to border on 'mental deficiency'. Born in the United States, and has been promoted regularly. Now in Grade 5B. Intellectually, he belongs in Grade 3B. Accepted in the second semester, on teacher's judgment. Not a case of special disability in spelling. Such weakness as he shows is general, and not special. His *general* failure to perform satisfactory work probably led to the teacher's recommendation.

14.

S. Sc. A boy, eleven years and six months old, of average intelligence. Born in Germany, and has been in the United States about two years. Has

attended public school during his residence in the United States, and was in school in Germany. Such deficiencies as he showed in spelling were apparently due to imperfect knowledge of English, as he had started his education in German. He learned quickly under special instruction. Could not be described as a case of disability in spelling in the sense in which we here use the term.

15.

S. Sh. A boy, eleven years and three months old, of average intelligence. Born in the United States, and attended public school. Now in Grade 5A. Mischievous child, with his interest and attention on pranks, rather than on school matters. Tractable and amiable, however, and amenable to the appeal of competition. A poor speller, with a tendency to 'forget' what had been recently learned. His disability is, however, mild as compared with that of M. G., P. J., and M. S.

16.

S. S. A girl, ten years and one month old, of superior intelligence. Born in the United States, and entered public school at the age of six years. Has 'skipped' one-half grade, and is now in 5B. Careless in written work, and dislikes to put forth effort in things that are not 'interesting' Has strong competitive tendencies, but wishes to succeed without drudgery, and sulks when beaten by others. Not a case of disability in spelling, as she learns quickly and retains what she learns, if she can be properly *motivated.* A good speller under stress of competition.

17.

M. S. A girl, eleven years and nine months old, of average intelligence. Born in Austria-Hungary, but has been in the United States since the age of two years. Entered public school at the age of five years (presumably kindergarten). Was in the hospital for one year, nature of illness unknown. Repeated Grade 2B, 'skipped' Grade 3B, and is now in Grade 5B. An amiable child, docile and conscientious, with decided charm of personality. Very conscious of her poor spelling, and anxious to improve, but unable to learn 'how to spell'. Her attempted spellings are 'wild' and frequently unintelligible. A clear case of special disability in spelling, as she has been in the United States since infancy, is of normal intelligence, and does satisfactory work in other school subjects, except where spelling enters in. (See samples of M. S.'s spelling, p. 78.)

18.

M. U. A girl, twelve years and ten months old, of very inferior intelligence. Born in London; has lived in the United States 'for several years'

Has attended public school for about six years, and repeated Grade 3A, and 'skipped' Grade 5A. She is now in Grade 5B. According to her intellectual capacity, she belongs in Grade 4B. A very poor speller, but her disability must be described as general rather than special, as she does poorly in all tests of mentality.

Among the eighteen children, who were selected as poor spellers according to the methods of selection described in Chapter II, and who were under our supervision for ten or twenty weeks each, we found causes of difficulty classifiable as follows:

Poor spelling due largely to poor and careless hand-writing and to an idiosyncrasy. H. A. (one case).

Poor spelling due to indifference, carelessness, lack of motivation, distaste for mental drudgery, intellectual laziness. M. Gl., J. P., S. S. (three cases). These are children of good intelligence, who learn quickly when motivated by hope of a reward, or by the idea of winning in a competitive game.

Poor spelling due to previous learning in a foreign language. S. Sc. (one case).

Poor spelling due to inferior general intelligence. L. K., H. L., H. R., M. U., R. H. (five cases).

Poor spelling due to lack of proper 'mind set', except when doing a spelling lesson *as such.* B. M. (one case).

Poor spelling due to an apparently mild special disability for forming the particular kinds of bonds involved in spelling. E. G., S. Sh. (two cases).

Poor spelling due to a serious degree of special disability for forming the particular kinds of bonds involved in spelling. P. J., M. S., M. G. (three cases).

Among our eighteen children, therefore, we found only three whose poor spelling could not be explained on some ground other than special defect. We found only three children, that is, who were native to the United States or had immigrated in infancy, who had attended public school from the age of six years, who had no sensory defects, who were of good intellectual quality, who put forth strenuous effort, and were nevertheless unable to form the bonds involved in spelling, sufficiently well to render their communications uniformly intelligible. This would be about two per cent. of the total fifth-grade enrollment in P. S. 192.

E. G. and S. Sh., though also very 'slow' in learning to spell, were much higher in the scale of spelling ability than were P. J.,

M. S., and M. G. The spelling of these two children was not so poor as to constitute a menace to future school progress; while the spelling of P. J., M. S., and M. G. was so bad as to imperil their standing in informational subjects like history, geography, and grammar, if these should be taught by means of *written* lessons or *written* examinations.

Samples chosen at random from the work of these three children are presented in Figs. 9, 10, and 11. If we are to rely on the statistics of this single study, we shall conclude that approximately two per cent. of school children have a special disability in spelling sufficiently serious in degree to hinder them somewhat in school progress, especially when they reach the upper grades of the elementary school and high school.

By far the greater proportion of the sum total of bad spelling is, however, due to *causes other than special disability* in forming the bonds involved in learning to spell words. Over eighty per cent. of the poor spellers in our Experimental Class spelled poorly from some cause other than special disability. General intellectual weakness, lack of interest, distaste for mental drudgery, intellectual inertia, previous learning in a foreign language, sensory defects, and bad hand-writing are doubtless the most frequent causes of poor spelling.

To differentiate among the possible causes of poor spelling in any given case is a task which calls for expert psychological knowledge. The quality of the child's general intelligence must be determined; he must be examined for sensory defects; his school history must be ascertained; his temperamental characteristics must be noted; and he must be tested for ability to form all the various kinds of bonds, according to the analysis of the spelling process in Chapter VIII.

Figs. 5, 6, 7, and 8, are presented to illustrate the work of children of various degrees of intellectual development. These illustrations will, perhaps, make somewhat more vivid the reader's conception of the imperfect correlation which exists between the general intelligence of children and their ability to spell. The samples presented are taken from a class exercise, chosen at random from the exercises given in the teaching of spelling. The words 'scholar', 'slender', straight', 'frosty', 'large', 'strange', and 'judge' had been taught to the group, according to the method adopted

by us for presenting new words (see p. 16). The paragraphs here given as samples were written by the children from dictation, and contain the words which had been taught. The paragraph, as dictated, reads as follows:

One frosty morning in December there appeared among the scholars a strange little fellow with a large head, great eyes, long, straight hair, a very thin body, and legs that looked like reeds, they were so slender. He could not have been more than ten years of age, to judge by his size, though his face looked far older.

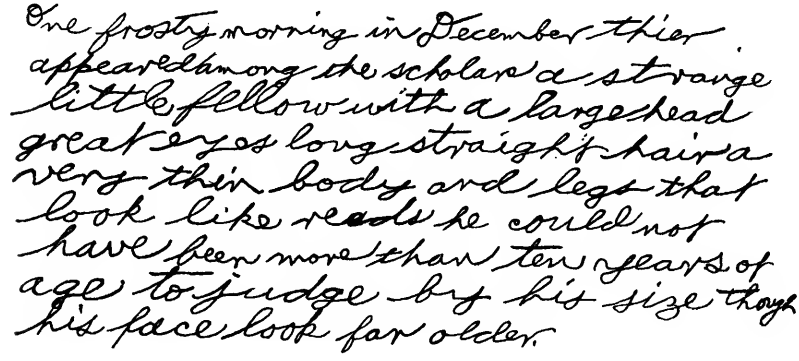

Fig. 5—Work of R. H. Chronological Age, Twelve Years Five Months; Mental Age, Nine Years Eight Months; I. Q., 78

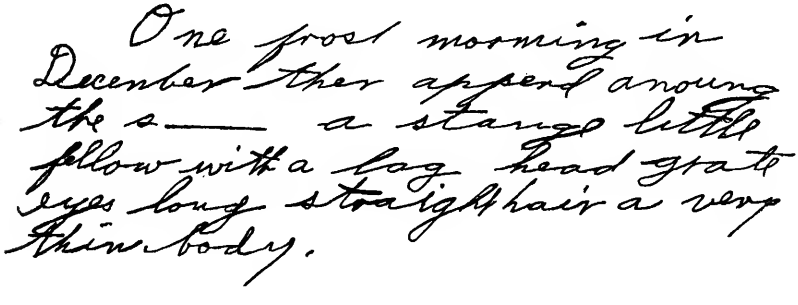

Fig. 6—Work of M. G. Chronological Age, Eleven Years Four Months; Mental Age, Eleven Years Six Months; I. Q., 101

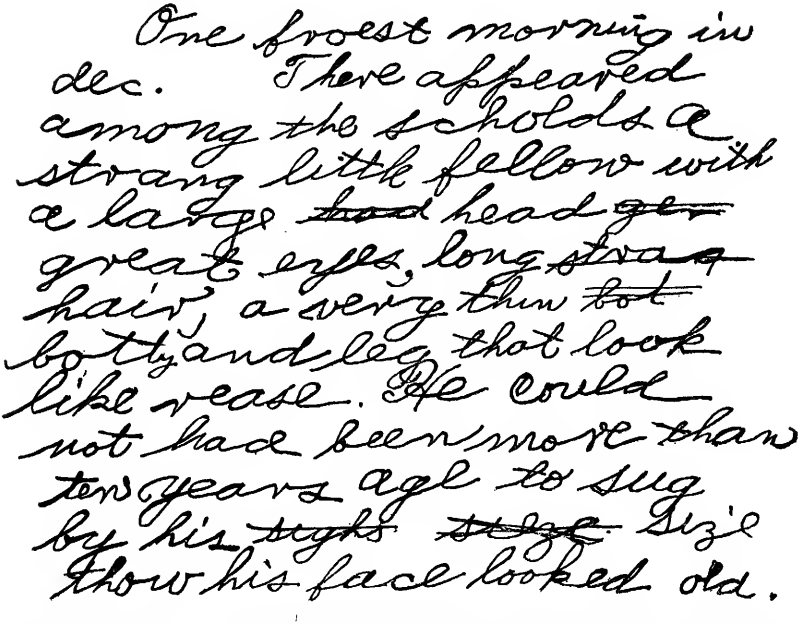

Fig. 7—Work of P J. Chronological Age, Eleven Years Five Months; Mental Age, Ten Years Four Months; I. Q., 91

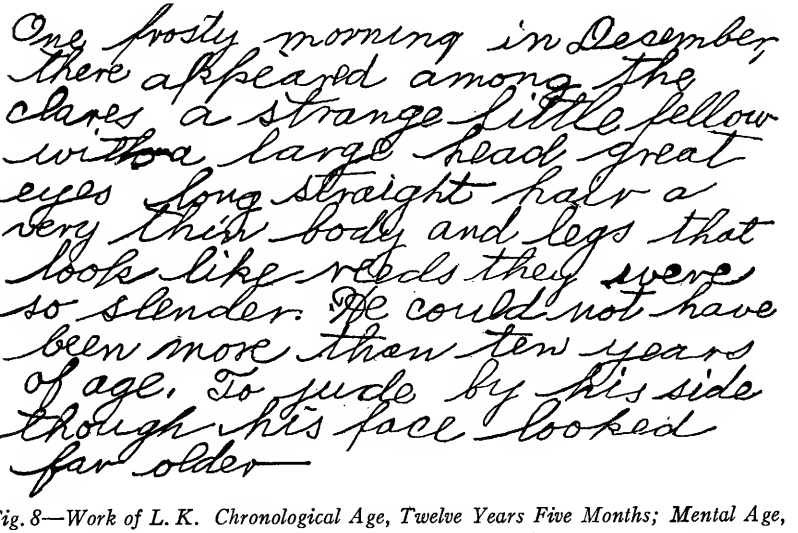

Fig. 8—Work of L. K. Chronological Age, Twelve Years Five Months; Mental Age, Ten Years Ten Months; I. Q., 85

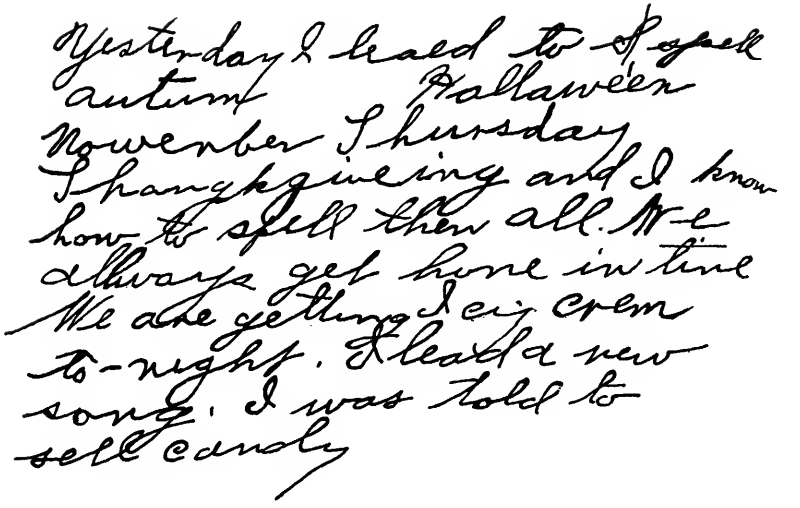

Fig. 9—Work of M. G. Written spontaneously, when requested to tell what took place at school and at home on the previous day

This is what was intended:

Yesterday I learned to spell autumn, Hallowe'en, November, Thursday, Thanksgiving, and I know how to spell them all. We always get home in time. We are getting ice-cream tonight. I learned a new song. I was told to sell candy.

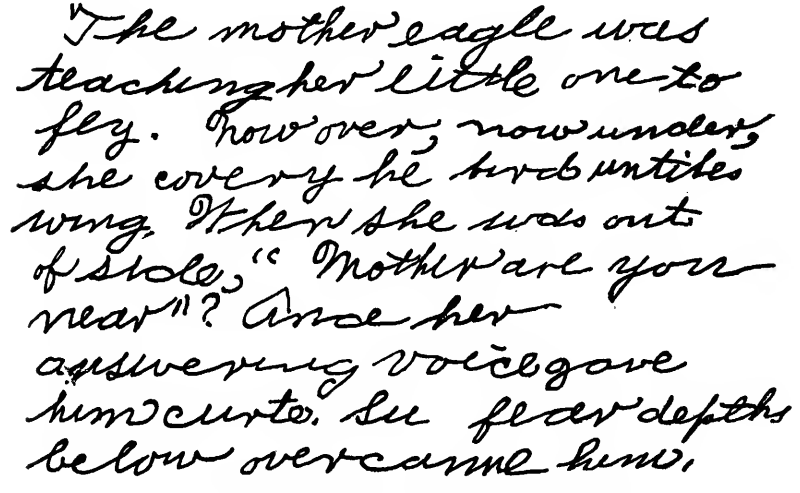

Fig. 10—Work of P. J. Written from dictation

This is what was intended:

The mother eagle was teaching her little one to fly. Now over, now under him hovered the bird on tireless wing. When she was out of sight he called, "Mother, are you near?" and her answering voice gave him courage. Suddenly the fear of the awful depths below overcame him.

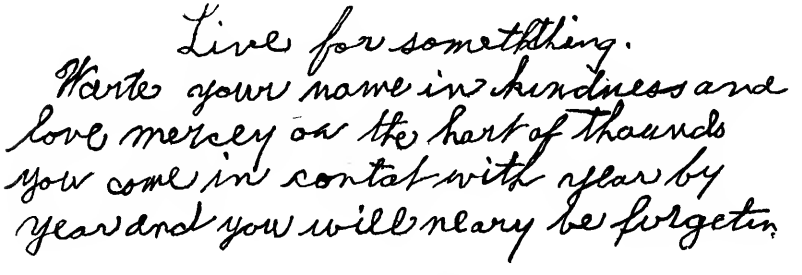

Fig. 11—Work of M. S. Written from dictation

This is what was intended:

Live for something. Write your name in kindness, love and mercy on the hearts of thousands you come in contact with year by year, and you will never be forgotten.

CHAPTER VIII

CONTRIBUTION TO THE THEORY OF SPECIAL LINGUISTIC DEFECT

The power of formulating, manipulating, and recording words is an ability in respect to which the overlapping between the human species and other animal species is almost zero. It is true that a few idiots would overlap with animals in such abilities as reading, spelling, and writing, but this overlapping would be slight between idiots and even the higher primates. Whereas in many mental traits there would undoubtedly be found by measurement to be a considerable amount of overlapping between large, random samplings of *genus homo* and large, random samplings of such animals as the dog, the horse, the elephant, and the ape, it is safe to predict that in ability to spell, men and brutes would fall into two sharply distinct and separate species, with very little overlapping between them.

Analysis teaches us that the aspect of linguistic attainment which we call *spelling* is by no means a simple process, involving merely the formation of a single bond or kind of bonds, between a given situation and a given response. The process of learning to spell a word correctly ordinarily involves the formation of a series of bonds, something like the following:

1. An object, act, quality, etc., is 'bound' to a certain sound, which has often been repeated while the object is pointed at, the act performed, etc. In order that the bond may become definitely established it is necessary (*a*) that the individual should be able to identify in consciousness the object, act, quality, etc., and (*b*) that he should be able to recollect the particular vocal sounds which have been associated therewith.

2. The sound (word) becomes 'bound' with performance of the highly complex muscular act necessary for articulating it.

3. Certain printed or written symbols, arbitrarily chosen, visually representing sound combinations, become 'bound' (*a*) with the recognized objects, acts, etc., and (*b*) with their vocal representatives; (so that when these *symbols* are presented to sight, the word can be uttered by the per-

ceiving individual). This is what we should call the ability 'to read' the word.

4. The separate symbols (letters) become associated with each other in the proper sequence, and have the effect of calling each other up to consciousness in the proper order. When this has taken place, we say that the individual can *spell orally.*

5. The child, by a slow, voluntary process, 'binds' the visual perceptions of the separate letters with the muscular movements of hand, arm, and fingers necessary to *copy* the word.

6. The child 'binds' the representatives in consciousness of the visual symbols with the motor responses necessary to produce the written word spontaneously, at pleasure.

It is interesting to note, as Bastian [1] points out, that the muscles of hand and fingers are to the fullest extent voluntary muscles, while the muscles concerned in the production of articulate speech are to a much less degree under voluntary direction. The individual *utters* words long before he is capable of *writing* words. The former ability develops normally at the mental level of about eighteen months; the latter, not until the mental level of at least six years.[2]

This analysis is not exhaustive, but it enables us to conceive how there might be a failure or modification in one or another of the series of bonds without interference with the other processes. For instance, we know that the blind can learn to spell. Thus in bonds considered under (2), (3), (4), and (5) the tactual sense takes the place of the visual. The person learns to spell without making use of the visual centers as normal children do. On the other hand, the deaf and dumb can learn to spell by means of hand and finger movements, and by 'reading' the lips of a teacher. Here the bonds noted under (2) and (4) may drop out entirely, and visual and kinaesthetic impressions are substituted for auditory impressions in (1) and (2). This demonstrates that the auditory centers are not essential to the process of learning to spell. We know also that it is possible for a child to spell words correctly without knowing the meaning of them at all.[3] Here the processes noted under (1) are absent.

[1] Bastian, H. C., Aphasia and Other Speech Defects, D. Appleton and Co., New York, 1898, p. 9.

[2] Terman, L. M., *op. cit.*, p. 233.

[3] See, for example, the case of R. H., among the children in our Experimental Class.

It is furthermore conceivable that the printed or written symbols mentioned under (3) might become imperfectly 'bound' to the sounds represented by them; or that the symbols and sounds might be properly connected, while the visual perceptions of separate letters might be imperfectly associated with the movements necessary to produce the word in writing, though all the other bonds had been successfully formed; or that one set of bonds, after being formed, might be destroyed, leaving all or some of the others intact. In a process so complex, involving the formation and perpetuation of so many *different kinds of bonds*, there may well be room for a great variety of combinations and permutations of imperfection, resulting in failure to spell correctly.

For about half a century neurologists have been reporting cases of cerebral lesion and of functional nervous disorder, involving special disability in written and spoken language. These reports are almost all dated after the publication by Broca [4] of his famous memoirs on the attempted localization of what he called 'the faculty of articulate language', in a limited convolutional region of the left cerebral hemisphere.

The cases reported and described in the literature of neurology show us that there are individuals in whom one set of bonds has been destroyed, either permanently or temporarily, without impairment of other sets of bonds. These are mainly cases of aphasia or amnesia, following cerebral hemorrhage or pathological changes in the cortex, or concomitant with very great emotional disturbance; cases in which the bonds have been *lost* by an individual, *who had succeeded in forming them.*

Case I.[5] G., aged sixty-six, a wood carver, entered the Bicêtre in 1887 on account of a right hemiplegia, without speech defect. In April of the following year he lost the power of articulating words. The loss of speech was absolute. He could not utter a single word, but could indicate the number of syllables in the names of objects shown him, by making the corresponding number of expiratory movements or squeezing the hand of his examiner. Intelligence was unimpaired. He was not deaf. He understood what he read, and wrote fluently with the left hand, either spontaneously or from

[4] Broca, P. P., Sur la Siège de la Faculté du Language Articulé, avec deux Observations d'Aphémie (Perte de la Parole), Paris, V. Masson et Fils, 1861.

[5] Déjerine, M. J., Contribution à l'Étude de l'Aphasie Motrice Sous-Corticale, et de la Localisation Cérébrale des Centres Laryngés, Séances et Mémoires de la Société de Biologie, 1891, p. 155.

dictation. The movements of tongue and palate were unimpaired. This condition lasted for two years, until the patient's death.

Case II.[6] A woman, seventy years of age, had an apoplectic attack, after which she remained unconscious for nearly twenty-four hours. She was then found to be hemiplegic on the right side, and quite speechless. After a few months she regained some words, and was able to read as formerly, but she could not write at all—could not even sign her name. Once before her death (which did not occur for four years after the hemiplegia), after a long effort to communicate in writing, she succeeded in forming the numerals 40, and sometimes, wishing to divide money, she would make the proper number of marks to indicate the amount of a share. That she knew what words she wanted was proved by the fact that she had recourse to the dictionary in her attempts to communicate. She knew and could identify the words, but could not speak nor write them.

Case III.[7] A patient, after suffering a slight right-sided stroke, lost entirely the power of reading. She did not even know the letters that she saw. She could write fluently and coherently, but could not read a word of what she had written. All her word memories were, however, not gone. By tracing the letters with a pencil she could read slowly, through her muscular sense. When she had in this way read a sentence its meaning was conveyed to her. But she could never be taught to read with her eyes again.

Case IV[8] A man, who before his illness wrote a good hand and spelled well, suffered a hemiplegia on the right side. Thereafter he could not form a single letter. Even with a copy before him, he could make only uncertain up-and-down strokes. The physician gave him some printed letters and asked him to spell out his name. After a long time he arranged JICMNOS. (The patient's name was James Simonds.) Before his illness he had been very particular about the spelling of his name, as it was one admitting of several variations. The spelling arranged by him shows some slight notion of the letters in his name. When a copy was placed before him, he quickly picked out the letters, and spelled his name correctly. This patient could read, but complained that reading made him dizzy.

Case V.[9] A woman, thirty-seven years of age, was admitted to the hospital with partial right hemiplegia. She could read aloud with facility, though without understanding what she read. The written words read

[6] Broadbent, W. H. On the Cerebral Mechanism of Speech and Thought. Transactions of the Royal Medical and Chirurgical Society, 1872, p. 145.

[7] Dana, C. L., The Study of a Case of Amnesia or 'Double Consciousness', *Psychological Review*, November, 1894, p. 577.

[8] Ogle, Wm., Transactions of the Royal Medical and Chirurgical Society, 1871 (referred to by H. C. Bastian, *op. cit.*, p. 110).

[9] Déjerine, M. J., Aphasie et Cécité des Mots, *Le Progrès Médical*, 1880, p. 629.

aloud by her aroused in her no idea; she read, so to speak, in a reflex fashion. When a sentence was dictated to her, she wrote it correctly, then read it, but without comprehending it any more than when one made her read a sentence taken from a book.

Case VI.[10] The patient was a man sixty-eight years old, of more than ordinary intelligence and culture, with partial right lateral hemianopsia, with complete hemiachromatopsia. There was preservation of ability to read figures and to calculate, and there was no disturbance of articulate speech. There was also perfect preservation of spontaneous writing and of writing from dictation. The patient could thus write whole pages correctly.

But *writing from a copy was very difficult and defective.* There was no impairment of general intelligence, but the ability to read words was lost.

Case VII.[11] B. N., a left-handed man, was admitted to the hospital suffering from incomplete left hemiplegia. He showed inability to read either printed or written words, or to name objects correctly; but general intelligence was preserved, and he was able to write quite legibly, although he could not read what he had written. When shown a piece of bread and asked what it was, he replied, "Un salière." A glass: "C'est une barre." A knife: he replied correctly. A book: "C'est une écorce pour faire des tartes." When asked to pick up the objects (the names being pronounced by the examiner) he did so without hesitation.

Case VIII.[12] A man aged thirty-four years, a bill clerk, not hemiplegic, but 'with a slight mental derangement', experienced sudden difficulty in spelling. He had no difficulty in thinking in speech; could write his name fairly well; could copy script and transpose printing into script, with scarcely an error. In writing spontaneously he transposed the letters in words, and added and omitted letters to such an extent that his communications were rendered unintelligible. When requested to spell words orally, he spelled them as badly as he had written them. No matter how badly he spelled the words, he could pronounce them correctly. Sometimes he noticed his misspellings, and sometimes he did not. Here the patient could read, write and copy; but he could not spell. The letters could not be revived *in proper sequence.*

The neurologists reporting these cases were interested mainly in their bearing on the attempted localization of various centers in

[10] Déjerine, M. J., Des Différentes Variétés de Cécité Verbale, *Séances et Mémoires de la Société de Biologie*, Fév. 27, 1892, p. 61.

[11] Bernheim, Contribution à l'Étude de l'Aphasie, De la Cécité Psychique des Choses, *Rev. de Méd.*, 1885, p. 625.

[12] Eskridge, J. T., and Parkhill, C., Cyst of the Brain in the Foot of the Left Second Frontal Convolution; Motor Agraphia from Inability to Spell, *Medical News*, August 1, 1896, p. 122.

the brain, and they present full details of necropsy, of disease history, and of the physical condition of the patients. For our purpose, all such details are omitted, and only those facts are quoted which show that *some of the bonds involved in the normal spelling process may be enfeebled or totally destroyed, while others remain intact.* The cases throw light upon our analysis of the bonds which must be formed and preserved intact in order that an individual may spell, and they constitute evidence that a large number of more or less independent factors are involved in spelling, so that we must expect great variability among individuals in ability to spell.

The cases show a great variety of kinds of interference with the use of words. In Case I all the bonds involved in the normal spelling process were preserved *except* those which in our analysis we noted under (2). *The bonds between the word and the complex muscular act necessary for articulating it were lost; all others remained intact.*

In Case II the bonds noted under (2) were greatly enfeebled, and those noted under (5) and (6) were destroyed completely. Here the bonds between words and the muscular act necessary to articulate them were greatly enfeebled; *the bonds between the visual perceptions of the letters and the muscular movements of hand, arm, and fingers necessary to copy, were destroyed; the bonds between the representatives in consciousness of the visual symbols, and the motor responses necessary to produce the written words spontaneously, were destroyed; all other bonds remained intact.*

In Case III the bonds under (3) and (4) were completely destroyed; the account leaves us somewhat in doubt as to just what was the condition of the bonds described under (5), since *tracing* the letters in written words does not necessarily involve the same bonds as those involved in *copying.* Here, therefore, *the bonds between the printed or written symbols (visually representing sound combinations), and the objects, acts, etc., represented, were destroyed; the bonds between the printed or written symbols and their vocal representatives were destroyed; we are left in doubt as to the state of the bonds between the visual perceptions of the separate letters and the muscular movements necessary to copy them; all other bonds remained intact.*

Case IV shows us an individual in whom the bonds noted under (4), (5), and (6) were destroyed. *The bonds between the separate letters in proper sequence were gone; the bonds between the visual per-*

ceptions of the separate letters and the muscular movements of arm, hand, and fingers necessary to copy the word, were destroyed; the bonds between the representatives in consciousness of the visual symbols, and the motor responses necessary to produce the written word spontaneously at pleasure, were destroyed; all other bonds remained intact.

In Case V we find a patient in whom the bonds described by us under (1) and under (3a) were destroyed. Here *the bonds between objects, acts, qualities, etc., and their vocal representatives were destroyed; the bonds between the visual symbols and the objects, acts, qualities, etc., were destroyed; all other bonds remained intact.*

In Case VI the patient had lost the bonds noted under (3), (4), and (5). *The bonds between printed or written symbols and objects, acts, etc., were destroyed; the bonds between printed or written symbols and their vocal representatives were destroyed; the bonds between the visual perceptions of the separate letters and the muscular movements of the arm, hand and fingers necessary to copy the word, were destroyed; all other bonds remained intact.* (In this case we note the peculiar fact that though the bonds between visually presented *words* and *concepts* were destroyed, the bonds between visually presented *numerals* and *concepts* were *not* destroyed.)

In Case VII the bonds noted under (1b) and under (3) were lost. *The bonds between objects and the particular vocal sounds representing them could not be revived by the patient; the bonds between written or printed symbols and objects, acts, etc., were destroyed; the bonds between printed or written symbols and the articulation of their vocal representatives were destroyed; all other bonds remained intact.*

In Case VIII the bonds described by us under (4) were gone. *The bonds between the separate letters (symbols), holding them in proper sequence, were destroyed, so that the letters no longer had the power of calling each other up in the prescribed order; all other bonds were intact.*

The particular bonds interfered with in Case VIII are those which commonly are thought of as constituting 'spelling', in and by themselves. That is, before we have made any analysis of the total process of 'learning to spell', we tend to think of spelling as the ability to arrange letters in their proper *sequence*, and as that only. Our analysis shows us, however, that learning to convey and receive communications by means of *spelled words* involves very much more than the element of *sequence*. Nevertheless, this

case is of somewhat more interest for us, perhaps, than some of the others.

Another case recently came under the attention of one of the present writers, in which the bonds involving *sequence of letters* were lost, all other bonds remaining intact. This patient could not *spell* words. He could make letters and combinations of letters, by hand and on the typewriter, could read perfectly, and articulate all words properly. The only bonds interfered with were those we have described under (4). The case was, briefly, as follows:

X, a well-educated and intelligent business man, of New York City, aged fifty-five years, sat down to his typewriter to write a letter, and found to his astonishment and discomfiture that his efforts produced an unintelligible jumble of letters. (He was well practised on the typewriter, and often used the machine.) Finding that he could not correct his blunders, he tried to write his letter by hand, but produced no better result. The ability to read was unimpaired; as soon as he had produced a word, he recognized at once that it was not the word he had intended; was, in fact, not any word at all. Greatly disconcerted, he took an old typewritten letter, and tried to *copy* it on the machine. He found that he could not even *copy* the letters in any intelligible sequence. Neither could he copy the letter by hand. The following is the letter which this patient tried to copy, together with his attempted copies of it:

Original Letter

Dear Sirs:

I beg to acknowledge the receipt of your letter of April 30, in regard to the standing of

I am informed from our Embassy in London that the British blacklist has been suspended. This information has been confirmed here through the Embassy and all firms formerly on the blacklist are entirely free from any restrictions.

Very truly yours,

COPY I.

(*Copy, on Typewriter, of Above Letter; First Day of Attack*)

Dear Sir:

I get to acknowdge the acokage the ackolagleg of the recepipe of the a of the reportcitate of Aplil 30th. in reprcliate of the recreprilate of

I am imformorn from our Emplacy inour recleiate the thre London the form Enblopny and the Emplicary as be any blackblack as be suspoblicay. The informaporty has be been comparity here here behly be bore hore thrus the busiher and Enapny, and all afriny frimformer on the afnly ame afre afraim are afrail ahrily and frnrily and any any from rerrafrientery.

COPY 2.

(*Copy, on the Typewriter, of Same Letter; Several Days Later*)

Dear Sir:

I beg to ackowlege the receipt of your letter of April 30 in regard to the standink of

I am informeted for our Emably in London that the Bricists blacklist has been suspoutosed.

Thais information has been conformation there through the Embassy formery on the blacklick are entirely free from any resprictions

Yery truly yours

COPY 3.

(*Copy of the Same Letter, Twelve Days After Copy No. 1*)

Dear Sirs:

I beg to acknowledge the recreipt of your latter of April 30 in regard to the standing of

I am informed from our Embassy in London that the British blacklist has been suspended. This information has been confirmed here thru [13] the Embassy, and all former formerly on the blacklist are entirely free from any restrictions.

Very truly yours,

The patient recovered from his disability in about twelve days. The various copies of the letter show his gradual clearing up, and the return to normal. The first copy is absolutely unintelligible. It conveys nothing to the mind of the reader, who does not already know what it is intended to convey. The form of letter writing is preserved; the paragraphing is correct; the two numerals are correctly copied (this is true in all three copies); but the *sequence of letters* is so interfered with as to render the communication senseless.

[13] The spontaneous spelling of the word *through* for this person is *thru*. In copying he spelled it thus, though it stands *through* in the original letter. In calling attention to this slip, the patient makes a note that *thru* is 'his way'.

The second copy (made five or six days after the first), is merely a very badly spelled letter. It is not much worse than are many of the attempted communications of our three poorest spellers in the Experimental Class.[14] The third copy is almost perfect, there being but one error in spelling a word (r-e-c-r-e-i-p-t for *receipt*), and one instance of writing one word for another (*former* for *firms*, when *firms* was to be followed by *formerly*). Both errors were corrected spontaneously by the patient. So we see that by the twelfth day after the hopeless jumble of letters produced in the first copy, the bonds controlling the sequence of letters in words were restored. No other bonds involved in communication by words had been lost. The patient was able throughout to understand, speak, read and write, and copy the visual symbols which make words; but he could not arrange these symbols in the prescribed *sequence*. He referred to his difficulty in these terms: "Something has happened to my *spelling*. I can't *spell*."

The temporary disability of this patient was due to a slight organic disturbance in the nervous system, the details of which are not of immediate interest for this discussion of the psychology of misspelling. All the cases which we have thus far considered in this chapter were due to definite pathological changes in the nervous systems of individuals who had already long ago formed all the bonds necessary for communication by words written, spoken, and read. The loss of bonds was in all cases sudden and selective; not like that loss which accompanies dementia, and comes from a lowering of the whole level of general intelligence. Their special disabilities were due to definite lesions, which were revealed at autopsy in the case of those who succumbed.

Let us turn now from these cases to certain other cases which have been reported in the literature of neurology and physiological psychology, as 'congenital alexia' and 'congenital agraphia' These are cases of persons affected with extreme disability in reading or writing, not by reason of any lesion,[15] but by reason of original ineptitude in these school subjects. A few such children are reported by neurologists, who are likely to see cases where the ability

[14] See spellings by M. G., M.S., and P. J. (pp. 75–77).

[15] A careful search through the literature of neuropathology and physiological psychology has failed to reveal any autopsy on a case of 'congenital alexia' or 'congenital agraphia', showing the disability to be due to a lesion, or any discoverable organic cause.

to learn is so deficient as to approach zero. These children are not physically ill in any way. Mentally and physically they are healthy, except for inability to learn a given school subject. Here there is *absence* of ability as distinguished from *loss* of ability. The child either has extreme difficulty in forming the necessary bonds, or is totally unable to form them. Such cases, for example, are the following:

Case A.[16] A youth aged eighteen years, well grown and healthy looking. He belongs to an intellectual family, and has himself always been a great favorite with his tutors and companions—excelling in all school sports.

He is the second of five children. Has had no severe illnesses except whooping cough when a child. He was extremely slow in learning to read—his father says they almost despaired of his doing so. When writing to me about him his doctor said: "He has strong common sense, and tries his best to do his school work, but his spelling is very bad, and he has great difficulty in reading and in remembering what he reads. Algebra and arithmetic give him little trouble. He works out his problems in a way of his own (which his masters describe as working backward) though he gets his results all right. He finds Euclid easy, unless he has to write out a problem." His father said: "He has very defective memory for words, but not for things which have happened, or for what people have said. He has an utter inability to see through a Latin sentence, even after going over it several times."

I found that he spoke naturally and freely—though he is said occasionally to bring out wrong words. Two letters to his parents were shown to me, in which many words were spelled wrongly. I have noted that he had written *hear* for *here*, that he had three times written *too* instead of *to*, and that he had written *toothack* for *toothache*.

He read to me a passage from one of Anthony Hope's novels in a very slow, hesitating manner, making occasional mistakes; for instance saying *on* for *no*, and *now* for *when*, while he stopped altogether at the word *moustache*, thought it was followed by the words 'on his upper lip'. He made also, after hesitating long, only a very poor attempt to pronounce the word *straddle*.

Case B.[17] A lad fourteen years of age was referred for examination because, although he had been under the instruction either at school or under tutors for seven years, he could "only with difficulty spell out words of one syllable." According to the report of the examining neurologist, "Words written or printed seem to convey no impression to his mind, and it is only after laboriously spelling them that he is able by the sound of the letters to discover their import." The boy could solve simple problems in algebra,

[16] Bastian, H. C., *op. cit.*, p. 180.

[17] Morgan, W. P., A Case of Congenital Word-Blindness, *British Medical Journal*, November 7, 1896.

from which fact it would be inferred that he was not feeble-minded, and could multiply three place digits correctly. He was not considered to be inferior in general intelligence. It is interesting to note that he could read numerals without difficulty.

Case C.[18] A girl eight years old cannot say the alphabet, although she can write it perfectly on occasions. She cannot spell words of two syllables, cannot read even material suited to beginners, and is unable to write from dictation. This child has attended school for two years. As data bearing on the determination of the level of general intelligence, we have the statements that she can count to twenty and write numerals to twelve; that she can repeat the days of the week, but not the months of the year; that she 'answers questions', can carry out errands, and 'has a good memory' From these few data on intelligence level, we should infer that the child was probably somewhat dull in general.

Case D.[19] Witmer reported in 1907 the case of a boy of fourteen, who showed special disability in reading and spelling. In this case certain psychological data are furnished, which tell us that general intelligence was normal; ability to communicate by means of speech was normal; auditory memory was good; visual memory for materials other than words was good. He could spell only such words as may be spelled phonetically. Witmer found that the boy was suffering from a bad case of diplopia, which may have interfered with the retention of visual impressions.

Other cases of extreme special defect in the ability to use words have been described by Hinshelwood,[20] Nettleship,[21] Town,[22] Bronner,[23] McCall,[24] McCready,[25] Stephenson, [26] Wernicke, [27] Thomas,[28]

[18] Whipham, T. R., Congenital Word- and Letter-Blindness, *British Journal of Children's Diseases*, vol. xiii, 1916.

[19] Witmer, L., A Case of Chronic Bad Spelling, *Amnesia Visualis Verbalis*, *Psychological Clinic*, August, 1907.

[20] Hinshelwood, J., Congenital Word-Blindness, *Lancet*, May, 1900. Congenital Word-Blindness, *Ophthalmic Review*, 1902.

[21] Nettleship, E., Cases of Congenital Word-Blindness or Inability to Learn to Read, *Ophthalmic Review*, 1901.

[22] Town, C. H., Congenital Aphasia, *Psychological Clinic*, November, 1911.

[23] Bronner, A., *op. cit.*

[24] McCall, E., Two Cases of Congenital Aphasia in Children, *British Medical Journal*, May, 1911.

[25] McCready, E. B., Congenital Word-Blindness as a Cause of Backwardness in School Children, *Pennsylvania Medical Journal*, January, 1910.

[26] Stephenson, S., Six Cases of Congenital Word-Blindness Affecting Three Generations of one Family, *Ophthalmoscope*, August, 1907.

[27] Wernicke, C., The Symptom-Complex of Aphasia. (In Diseases of the Nervous System, Edited by A. Church, 1908.)

[28] Thomas, C. J., The Aphasias of Childhood, Public Health (London), 1908.

and Brissaud.[29] Except in the reports of Bronner and of Town, there was practically no psychological study of the cases described. In most instances we cannot be certain that the child in question was even of normal intellectual status, as no standardized tests for the determination of intelligence level were used. Indeed, as Bronner points out, in one instance, tasks now standardized at the four-year level of intelligence are cited as evidence of good mental endowment in the case of an eleven-year-old boy. The two following cases of almost complete disability in spelling, accompanied by general intelligence average and above the average, have recently passed under the observation of one of the present writers.

The first is the case of a school boy, Y, fourteen years of age, a native American, referred to one of the present writers by his teacher, who reported that she believed him to be of normal intelligence, as he had executive ability, could carry out commissions very well, loved birds and animals, and knew their haunts and habits, and could do all school work which did not involve reading and spelling. In reading and spelling, he was 'hopeless', and seemed unable to learn them by any method or means. Because of this extreme disability, he had reached only the fifth grade at the age of fourteen years. Some of his former teachers had been of the opinion that he must be feeble-minded.

On examination it was found that the boy had a serious defect of vision, but this was corrected by glasses, which he had worn for a long time. Wearing his glasses, he was able to see, and reproduce from memory, designs used in the psychological laboratory for testing visual memory, so that the visual defect did not prevent correct perception of objects and symbols. There was no defect of hearing. On the scale of intellect he measured at a mental level of thirteen years and two months. Since his actual age on the date of examination was fourteen years and two months, his Intelligence Quotient is ninety-three per cent.

As a test of his ability to read, he was presented with the following paragraph:

> New York, September 5th. A fire last night burned three houses near the center of the city. It took some time to put it out. The loss was fifty thousand dollars, and seventeen families lost their homes. In saving a girl who was asleep in bed, a fireman was burned on the hands.

[29] Brissaud, M., Cécité Verbale Congénitale, *Revue Neurologique*, 1904.

He read a few of the simpler monosyllables such as 'the', 'A', 'in', and 'was', but was unable to make any sense out of the paragraph, miscalling words in an apparently random way, and omitting words. The communication meant nothing to him, as seen by him on the paper. When the examiner read it to him, he understood every word, and gave back the meaning and content of the paragraph very well.

He was tested for spelling with ten words, being asked first to write them, and afterwards to spell them orally. He was able to define each of the ten words and to use it in a sentence. The words were:

1. cannot
2. September
3. burned
4. houses
5. center
6. thousand
7. fifty
8. families
9. defends
10. bravely

Fig. 12 is a fac-simile of the written spelling of this boy. The examiner pronounced the words one by one very distinctly, and he wrote them on paper.

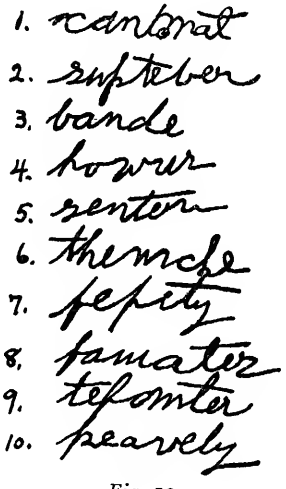

Fig. 12

After this exercise was accomplished, the examiner pronounced the words again, and the boy spelled them orally, with the following result.

1. cannot—c-o-n-n-e-c-t
2. September—s-u-p-b-e-r
3. burned—b-u-n-d
4. houses—h-o-u-r-s-e-s
5. center—s-a-n-t-e-r
6. thousand—t-h
7. fifty—f-u-t-e-y or f-u-t-e-r
8. families—f-o-n-a-l-l-y-s
9. defends—d-e-f-n-y
10. bravely—b-e-a-l-y

This boy was probably sufficiently poor in spelling and reading to be classified as a case of 'congenital aphasia' by neurologists. His ability to communicate by or receive communications through written or printed language approached zero. Though he was of normal intelligence, his ability to read and spell was no better than that of imbeciles of his own age. He showed a *very extreme degree* of special disability in these two school subjects.

Yet inspection will tell us that his errors are different from those of our poor spellers, P. J., M. S., and M. G., *not in kind*, but only in degree. *The initial element* in his misspellings is nearly always right; and he is controlled rather closely by the *length* of the words he is trying to spell. He is several degrees lower on the scale of Spelling Ability than is any of our three poorest spellers, but his errors are of the same *kind* as theirs.

Although this boy had always been 'delicate', and had been afflicted with many diseases of childhood, no history of organic disorder of the nervous system could be elicited from the mother. There was no history of a convulsion, or of a paralysis, and no history of otitis media. As already stated, there was no defect of hearing, and defects of vision had been for a long time corrected by the use of lenses.

It is interesting to know that the boy has a sister, who is reported to be almost as poor in ability to read and spell as he is, and that the father is said to be 'slow at reading'

The second case is that of a school girl, Z, aged eight years, also a native child. She was referred for mental examination by the principal of the school where she was in attendance. The teacher had reported on her case as follows:

> Reading good; Oral English good; General knowledge good; Initiative good; Arithmetic, memory work fair, reasoning poor; Spelling zero. She can't seem to learn spelling. She tries very hard, but it 'goes'. The guesses she makes are *wild*. Her written work is, of course, very poor. Penmanship is awful! To teach her spelling I have tried oral, oral and written, written. None seems to have any advantage.

This child had been examined for visual and auditory acuity, and was reported as normal in these respects. Her mental level was ten years and six months. Since her actual age was eight years and three months at the time of measurement, her Intelligence Quotient is 127 per cent. When tested for reading with the paragraph beginning, "New York. September 5th. A fire last night, etc.," she read it in thirty seconds, with but two slight errors, and reproduced the thought from memory, giving twelve details correctly. This is a performance standardized at the ten-year-level of intelligence.

When tested for Spelling Ability with simple words selected from the paragraph which she had just read, the guesses which she made were indeed 'wild'. Asked to spell 'night', she wrote 'n-i-t-y' Having produced this result, she read it at once as 'nity', pronouncing it with a short 'i', and observed, "It isn't right." Told to correct it she made further attempts with even less promising results. Asked to spell 'houses', she produced the following consecutive misspellings:

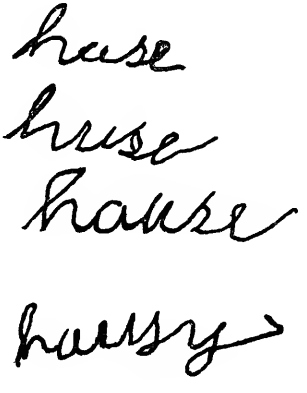

Fig. 13

She never succeeded in writing the correct spelling of 'houses', though the examiner spelled it orally for her twice. As soon as the child had finished writing her absurd spellings, she knew at once that they were wrong, but could not correct them. The bonds described by us under (4) and (6) could be formed not at all, or only with the greatest difficulty, by this child. Unfortunately, she was

not tested at this examination for copying, so that no certain statement can be made with regard to the bonds described under (5). All other bonds involved in the spelling process were readily formed by her. She knew the meanings of words, could articulate them perfectly, and could read them; but she could not bind the letters composing words in the proper sequence, and could not make the motor responses necessary to produce the correctly spelled word spontaneously.

In certain respects her case reminds us of the case of the gentleman whose typewritten letters are reproduced here (p. 87). This child had difficulty in *forming* those same bonds which he *lost* temporarily when a slight pathological change took place in the nervous system. The child, however, was in the best of health, had suffered no severe illnesses, and had developed normally, physically, and mentally, except that she had been from the first unable to learn to *spell.* She was in the third grade at the time of examination, which is the standard grade for eight-year-olds, so that her disability had not as yet operated to hold her back in school. Since she is of distinctly superior general intelligence, it is possible that she may manage to make her promotions regularly, for she can read very well, and if allowed to recite orally, can give evidence that she has acquired the information contained in what she has read. But if compelled to communicate knowledge gained by means of written lessons, and written examinations, she will undoubtedly fail in nearly all school subjects. If her difficulty is not understood by her teachers, she will be almost as severely handicapped in school as though she were feeble-minded.

The thesis suggested by psychological examination of these extreme cases, and by the total work done with the poor spellers in our experimental class, is that *ability to spell is a complex trait, which distributes itself over a normal distribution curve; and that the rare extreme cases described as 'congenital word-blindness', 'congenital alexia', 'congenital agraphia', and 'Amnesia Visualis Verbalis', form the very fag end of this normal distribution.* According to this view, inability to learn to spell would not be thought of as due to 'some damage to the visual word center in early childhood', or 'to congenital localized neural lesions', as has been supposed by neurologists, who reason from analogy with those pathological cases where *loss* of ability ensues. According to our view, these congenital disabili-

ties result as other mental traits result, from the operation of the unknown laws of heredity and variation, and not from the supervention of a trauma or lesion, but for which the child in question would have had 'normal' ability. This is our view so far as spelling ability, at least, is concerned. Bronner [30] expresses an opinion which would lead to much the same view with respect to reading ability. She says: "At the present stage of our knowledge there is no establishing by symptoms the fact of congenital localized neural lesions or defects analogous to acquired lesions, and our case-histories show that inability to learn to read may rest upon a basis of various defective powers."

The question is analogous to the question in the case of 'idiocy' According to the ancient view, 'idiots' formed a separate intellectual species, set apart from 'normals' by some definite pathological condition, but for which they would have been 'normal' Since the research of Norsworthy [31] and Binet [32] we know that the feeble-minded do not form a separate intellectual or physical species. They form the lower end of the continuous curve of distribution for human intelligence; they result just as the mediocre and the superior result—from the operation of the unknown laws of heredity and variation; and they are no more to be regarded as 'pathological' than are the exceptionally superior individuals, who are as far above mediocrity as they are below it.[33]

Just so, children with extremely feeble ability in reading, spelling and writing have been thought of as set apart by a pathological condition. Names have been given to their weaknesses, to indicate that they are 'set apart' It has been said of them that 'they have alexia' or 'they have aphasia', much as one might say 'they have typhoid fever' Obviously, one has or has not typhoid fever.

[30] Bronner, A., *op. cit.*, p. 88.

[31] Norsworthy, N., The Psychology of Mentally Deficient Children, *Archives of Psychology*, Columbia University, 1906.

[32] Binet, A., The Intelligence of the Feeble-Minded. (Translated by E. Kite.) Published by The Training School, Vineland, N. J., 1916.

[33] We are, of course, speaking of what Tredgold (Mental Deficiency, 1914) calls 'primary aments', those cases which in medical terminology are described as 'idiopathic', where 'no etiological factor other than heredity' can be found. These cases include approximately ninety per cent. of all persons sufficiently inferior to be classified as 'feeble-minded'. It is, of course, recognized that a small percentage of mental deficiency is due to the supervention of disease. These 'secondary' cases are not included in the above discussion.

There are no 'borderline cases' in that affliction. The condition is due to the presence of a definite pathological disturbance, and those who 'have it' are definitely set apart from those who have not.

Our results from the quantitative measurement of poor spellers suggest that they are continuous with the distribution of spellers in general; that the unbroken curve of spelling ability will include them as its fag end. In an ability involving the formation of so many hundreds of bonds of so many different kinds, obviously there is much chance for variation to occur. We should expect from our knowledge of the laws of chance, that in a process so complex as this there will be a great *variety* of capacity to learn, even among persons of the same degree of general intelligence.

If subsequent measurements of large numbers of poor spellers, and of spellers chosen at random, should confirm this view of special linguistic defect, what is the implication as to remedies? We found in our experimental work that a number of the poor spellers were lacking merely in interest and application. The ability to form bonds was present, but motivation was lacking. The tedious, voluntary effort requisite for forming the thousands of bonds involved in learning our arbitrary English spelling was too irksome for them. When devices to make learning 'interesting' and 'worth while' were employed, and when rewards of value *to the child* were offered, these poor spellers improved rapidly, and lost all semblance of inability to spell. Such children were S. S. and J. P., both of whom spelled poorly in their written school work (though they spelled words in a column fairly well, even at first). When adequate stimuli were applied, these children became good spellers.

But after all the poor spelling due to lack of motive, weak general intelligence, failure to attend, sensory deficiencies and weak power of sustained effort was accounted for, there still remained a residue of poor spelling which resulted from none of these causes, but from an innate inability to form some or all of the special bonds requisite for spelling words. Let us take, for example, the three girls, M. G., M. S., and P. J. All were of normal intelligence; all worked hard under the stimulus of competitive effort to win a reward; none was afflicted with visual or auditory defects. In matters involving general intelligence, they saw and heard as well as the other children. Yet these three children remained extremely poor in spelling

throughout the course of the experimental teaching. They made a relative gain, as may be seen by reference to their records (pp. 60–62), but absolutely they gained very little. At the end of twenty weeks of special instruction in spelling, M. G. and P. J. had less spelling ability than an eight-year-old child.

Cases like M. G., M. S., and P. J., Y and Z, and the cases of extreme disability reported by other authors, and here referred to, are those which we have to consider from the point of view of our theory. What is the outlook for these children? Can they learn to spell as well as the average person spells? And if so, by what methods? If our view of their cases, based on our experimental evidence, is the correct one, we should answer that they cannot learn to spell as well as the average person spells. They are, however, able to learn to spell with varying degrees of success, each according to the original ability which he has to form the special bonds involved in producing that result, which we call *correctly spelled words.*

Since they are continuous with children in general in such ability it follows that, broadly speaking, they may be taught in the same way and by the same methods which are most advantageously employed with children at large. By this statement is meant that their disability calls for no mysterious or unique process of inculcation, which would apply to them, but not to ordinary children. Teaching in the case of a child with extreme special disability in spelling may well be greatly facilitated, however, by psychological analysis, conducted with a view to determining which of the necessary bonds are most difficult for him to form, or whether the bonds are all of equal difficulty.

For example, it may be that all bonds are easily formed except those which 'bind' the arbitrarily chosen visual symbols with the vocal representatives of objects, acts, qualities, etc. Special practice might then be given in making the responses which lead to the establishment of those particular bonds. This would be practice in *pronunciation.* Or it may be that all responses are easily made except those motor responses, which are necessary to produce the written word. In this case special emphasis might be laid upon practice in *writing;* or the child might be allowed to use a typewriter for his written work. A great variety of similar possibilities will come to mind, upon consideration of the analysis of the spell-

ing process attempted in this chapter. 'Poor spelling' may be simply deficient knowledge of the meaning of words; defective pronunciation; difficulty in associating or 'binding' visual symbols with auditory symbols; difficulty in establishing associations in the proper sequence; motor awkwardness and incoordination; or it may be a combination of any or all of these difficulties and deficiencies.

SUMMARY AND CONCLUSIONS

On the basis of our experimental study of disability in spelling we thus arrive at certain general conclusions, among the most significant of which are the following:

1. Among poor spellers, disability is not necessarily a function of the quality of general intelligence. Children of the same mental level, of the same intelligence quotient, and of the same school training differ among themselves very markedly in spelling ability. In rare cases children who are of superior general intelligence may be unable to master spelling. To differentiate between poor spelling due to special disability and poor spelling due to other causes requires skill in psychological diagnosis, and knowledge of the various bonds involved in the normal spelling process.

2. Ability to spell is not a simple unit, involving merely the formation of a single bond or kind of bonds, between a given stimulus and a given response.

3. The great complexity of the bonds which, when formed, enable the individual to communicate by means of correctly spelled words, is made evident by a consideration of cases in which there is a selective loss or enfeeblement of some of the necessary bonds, with the preservation of all other necessary bonds. These are cases of cortical and subcortical lesion, and of functional nervous disorder.

4. The large number of relatively or totally independent factors thus shown to be involved, would lead us, by our knowledge of the laws of chance, to expect great variability among individuals in ability to spell.

5. We find, as a matter of fact, that there is great variability (our results in this respect merely confirming the results of other investigators), and we find a few children of normal intellectual capacity whose ability to spell approaches zero. These have hitherto been regarded as 'pathological' cases, set apart by lesions, this view of their condition having been arrived at by reasoning from analogy with the cases of organic disorder cited here in Chapter VIII.

6. Our results lead to the conclusion that these extreme cases differ from each other in degree of defect, and are continuous with children in general in spelling ability; that they form merely the fag

end of the normal curve of distribution in this ability. Investigation shows that their errors are determined by the same factors and follow the same laws as errors in general. Their failures are far more numerous than are the errors of better spellers, but qualitatively they are the same.

It might be argued that these facts of qualitative similarity do not prove the non-existence of lesions, as it is possible that the errors of patients known to be suffering from organic disorder would also conform to the laws of error in general—an hypothesis which we have not here disproved. Unfortunately not enough spellings of patients affected with cerebral lesions have been placed on record, so that analysis of their efforts is possible. In many of the cases reported the bonds involved in written spelling (those described in our analysis under (6), p. 80) are either wholly lost (agraphia), or else quite intact. In neither case would any misspellings be produced by the patient as a written record. It is only when the bonds described under (6) remain intact or nearly so, while the bonds described under (4) are enfeebled or lost, that such patients produce graphic misspellings. Eskridge and Parkhill present samples of the misspellings of their patient, but these samples consist of only a few lines of writing.

The misspellings of our patient X (see p. 87) appear to differ qualitatively in many respects from the misspellings of our poor spellers in the Experimental Class. The misspellings of X suggest a species of 'graphic stammering' A word once undertaken seems to perseverate, and to mix itself with other words subsequently attempted, as for instance in Copy 1, "I get to acknowdge the acokage the ackolagleg, etc." Here the word "acknowledge" perseverates for the length of a whole line, so that it is impossible to say what words are really intended. Copy 2, in the case of X, does not show this quality. Here the extent of the patient's error is obviously influenced by the length of the words and by the first elements. His constant error in the length of misspelled words is, however, in the direction of making them *too long*, which is contrary to the findings in the case of our children.

It would be desirable to analyze the misspellings of a number of patients like X and the patient of Eskridge and Parkhill, according to the method adopted by us in our work with the children of the Experimental Class.

7. Since the poorest spellers are evidently continuous with children in general in spelling ability, but differ from average children (and from each other) in degree, it follows that they can equal children who stand above them in original capacity either not at all, or only by the exercise of relatively great effort. A few of the very extreme cases of disability will be unable to learn to spell, even with the maximum of effort.

8. For pedagogy the implication is that the extremely poor spellers may best be taught by the methods which are most advantageously employed with children in general. But, since ability to spell is the resultant of a variety of contributory abilities, we should expect to find that cases of poor spelling differ very much among themselves upon analysis of their difficulty. Of three children equally poor in ability as measured on a Spelling Scale, the one may require special drill in forming bonds between the sounds of words and the muscular acts necessary for articulating them; another may need special practice in 'binding' the arbitrary, written or printed, symbols with the sounds which represent objects, acts, etc.; the third may experience special difficulty in forming the bonds between the representatives in consciousness of the visual symbols, and the motor responses necessary to produce the written word spontaneously, at pleasure. There is no one specific remedy for poor spelling.

9. The analyses suggested in the case of poor spellers might equally well be made in the case of mediocre and good spellers, with intent to improve them also.

10. In cases where the disability is very extreme in a child of good general capacity, as in the case of Z, it is probably wise to make some special provision for oral recitation and examination, and thus to allow the child to proceed in school, rather than to keep him back year after year on account of his disability. In cases where there is disability in both spelling and reading, as in the case of Y, the child will be at approximately as great a disadvantage in the ordinary schoolroom as though he were blind. From the practical point of view, it is probably wisest that such children should be trained in skilled trades, where communication of ideas by means of written or printed words is relatively or quite inessential.

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